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Rural University:
Learning about Education and Development

Farzam Arbab

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ABSTRACT

The experiences of the Fundación para la Aplicación y Enseñanza de las Ciencias (FUNDAEC) from its inception in 1974 up to mid-1982 are described. During these years FUNDAEC developed a rural university as an institution of learning for the inhabitants of Norte del Cauca, a rural region near the city of Cali in Colombia. The tasks of the rural university have been defined in terms of a series of learning processes which are to be set in motion in all the villages of the region. These learning processes fall into three main categories, the development of human resources, the application of science, and the strengthening of community structures. At the heart of the strategies of the rural university has been an educational program to endow the region with a pyramid of workers in rural well-being: engineers, technicians, and promoters. The details of the very successful educational innovation that made accelerated learning possible for the youth are discussed in these pages. The experiences of the students and their professors in setting in motion learning processes, especially those concerned with alternative production systems, associations for production, propagation of technology, and marketing systems, are also described in detail.

RÉSUMÉ

Cette publication passe en revue les réalisations de la Fundación para la Aplicación y Enseñanza de las Ciencias (FUNDAEC) depuis sa création, en 1974, jusqu'au milieu de l'année 1982. Ainsi, la FUNDAEC a mis sur pied une université rurale pour les habitants de la région de Norte del Cauca, près de Cali, en Colombie. Le mandat de l'université est de mettre en oeuvre, dans tous les villages de la région, divers programmes d'études dans trois domaines principaux : développement des ressources humaines, application de la science et renforcement des structures communautaires. On retrouve, au centre des stratégies de l'université rurale, un programme d'éducation visant la formation de travailleurs qui contribueront au bien-être des populations rurales : ingénieurs, techniciens et promoteurs. Ce programme innovateur qui a permis à la jeunesse de faire un apprentissage rapide a connu beaucoup de succès. Il est présenté en détails dans cette publication, comme le sont les expériences des étudiants et des enseignants dans la mise en oeuvre de processus d'apprentissage, surtout ceux qui touchent les nouveaux systèmes de production, les coopératives de production, la diffusion de la technologie et les systèmes de commercialisation.

RESUMEN

Este trabajo describe las experiencias que desde sus comienzos en 1974 hasta mediados de 1982 ha tenido la Fundación para la Aplicación y Enseñanza de las Ciencias (FUNDAEC). Durante estos años, FUNDAEC desarrolló una universidad rural que sirve como institución de aprendizaje para los habitantes del Norte del Cauca, una zona rural cercana a la ciudad de Cali, en Colombia. Las tareas de la universidad rural implican poner en marcha una serie de procesos de aprendizaje en todas las aldeas de la región. Estos procesos de aprendizaje abarcan tres categorías centrales: desarrollo de recursos humanos, aplicaciones de la ciencia y fortalecimiento de las estructuras comunitarias. Las estrategias de la universidad rural han tenido como mira un programa educativo que dote a la región con una escala de trabajadores para el bienestar rural: ingenieros, técnicos y promotores. Los detalles de la exitosa innovación educativa que permitió el aprendizaje acelerado por parte de los jóvenes son objeto de discusión en estas páginas. También se describen en detalle las experiencias que han tenido estudiantes y profesores para poner en marcha los procesos de aprendizaje, especialmente aquellos relacionados con los sistemas alternativos de producción, las asociaciones de producción, la difusión de tecnología y los sistemas de mercadeo.

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FOREWORD

Researchers are concerned that their results should be understood and used. Indeed, one of the most interesting debates concerning research in recent years has been the relationship between research and action to the point that it has resulted in a "subspecies" called, not inappropriately, "action research." Although the experience of following the debate has not been without its frustrations, two general lessons are now apparent. First, that to concentrate on action or on research and to exclude the other leads to an unsatisfactory understanding of the development process and so limits any possible impact that the activity is likely to have. Second, research that is likely to have the greatest impact has to be framed with action and diffusion in mind from the beginning. These lessons have been learned after considerable experience but are difficult to transfer from one institution to another.

The value of *Rural University* is that it explains how one institution set about the task of transferring knowledge into action. There are few case studies to guide other institutions who wish to set about a similar activity and this study, written by one of the prime movers, will be helpful not only as an evaluation but also as a comparison for similar institutions. There are, to be sure, a number of special, possibly local, circumstances that account for the success of the Fundación para la Aplicación y Enseñanza de las Ciencias (FUNDAEC) but among the more general lessons is the emphasis that education is not a static system but a process that evolves and changes. Learning, therefore, becomes the heart of the development process and influences not only what is learned but how it is learned. FUNDAEC itself has changed during the course of its first 8 years and if this account is updated, as I hope it will be, we shall find that FUNDAEC has changed yet again. Learning and change become the method of understanding the development process of the community.

The publication of this book by the International Development Research Centre not only illustrates the continued commitment by the Centre to rural experimentation but also represents a recognition of how much we have learned, as an agency, from this particular research group. I know that I write for my colleagues in the Agriculture, Food and Nutrition Sciences and Social Sciences divisions as well as other parts of the Centre in expressing our admiration for FUNDAEC's work and for the lessons in dedication and skill that they have shown us. Although the book represents a collective enterprise, it is fitting that it has been written by Farzam Arbab who has taught so many of us to look at rural communities in a new and productive way. We hope that in sponsoring this book others will learn of and from this interesting development experiment.

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PREFACE

This is the account of an experience in rural education and development to which many people have contributed over a period of about a decade. The small group that participated in the entire program from the beginning was formed between 1974 and 1976, although three of us, all professors of physics at the Universidad del Valle in Cali, Colombia, had been discussing some of the educational ideas with a group of our students since 1971. During the 1960s, the Universidad del Valle had enjoyed a great deal of support especially from the Rockefeller Foundation as one of the universities around the world to become a model institution to lead regional development. In 1971, student movements suddenly interrupted what seemed to be a very successful process of institution building and the entire model came under criticism. It did not seem to us, however, that the ensuing debate went beyond superficial analysis of social factors or ever touched the profound crisis in the basic assumptions of education, whether in natural or social sciences, medicine or engineering, the arts or the humanities. Although some of the conversation of the groups involved in the controversy centred around the conditions of the masses, we felt that the connection between university crisis and the irrelevance of the content of the educational system to the life of the poor was seldom examined with clarity. We decided, then, to become intensely involved in the processes of community life in a nearby rural region and search for the content and the form of "education for development." The Rockefeller Foundation agreed to support our first efforts to create a private foundation, FUNDAEC, to consolidate our group, and to begin certain educational programs. Fundación para la Educación Superior (FES) was the first Colombian institution to offer us help. Later on, a number of other agencies, International Development Research Centre (IDRC), the Interamerican Foundation, Private Agencies Collaborating Together (PACT), Volunteers in Technical Assistance (VITA), Appropriate Technology International, as well as the Colombian Ministries of Education, Agriculture, and Planning, contributed to the expansion of FUNDAEC and the consolidation of its work in Norte del Cauca where all of its activities during the first 7 years were concentrated. Expanded activities brought new talent to our group among whom we should at least mention Jaime Millan, Jairo Roldan, Carmen Inez Gamboa, Ana Gonzalez, Enrique Castellanos, Roberto Hernandez, Alan Fryback, and Gabriel Carrasquilla.

The experience described in the next pages only takes us to the middle of 1982, when FUNDAEC was in the midst of a process of autoevaluation, transition, and expansion to other regions. Since then, many of its plans have met with further success and have confirmed the optimism with which this account was written. The description presented here does not have the characteristics of a research report and undoubtedly reflects the biases and the emotions of a group that has tried to describe its experience as objectively as the nature of its activities permits. We hope that other groups involved in similar endeavours will find this

presentation useful and that it will serve to draw the attention of concerned individuals and institutions to the urgent need for the reexamination of the concepts of rural development prevalent during the past few decades.

The people who formed the core of the FUNDAEC group during the period treated in this book were Alberto Alzate, Farzam Arbab, Gustavo Correa, Edmundo Gutierrez, Martin Prager, and Francia de Valcárcel. One of us was chosen to write this account but, of course, everyone contributed to its content.

Farzam Arbab

THE PHILOSOPHY

FUNDAEC (Fundación para la Aplicación y Enseñanza de las Ciencias) was created in 1974 by a small group of professors from the Universidad del Valle in Colombia at a time when the role of education in development was being critically questioned throughout the university. During the late 60s and early 70s, it was becoming increasingly evident that development, defined mostly in terms of industrialization, was failing many of its basic objectives and was not improving the living conditions of the vast majority of the inhabitants of the developing countries. Traditional indicators, such as the gross national product, measured growth but said little about the well-being of the poor; in spite of economic advances in many countries, the conditions of the majority as far as health, nutrition, housing, and real income were concerned, had not improved appreciably and, in many cases, seemed to have worsened. It was repeatedly stated that development had created two separate sectors in the developing countries — a small modern sector, living the lifestyle of the industrialized nations with the same values, cultural patterns and aspirations, and a traditional sector, mostly rural or in the process of migration to the urban slums, dedicating all of its efforts to subsistence: food, clothing, and shelter.

Researchers were contemplating projects that would work more directly with the community and the results of which would be measured by indicators of the well-being of the population of a region. Concern with the well-being of specific communities, and an understanding of the problems they faced, had an effect on the composition of research action groups, which immediately became interdisciplinary and turned their attention to multisectoral actions. Within a multisectoral approach to development, education was gaining in importance, especially as a support for other activities. Nonformal education was spreading widely, although its merits were often exaggerated.

Integrated Action

A number of interdisciplinary groups were created in Colombia during this same period. Those concerned with rural life argued that rural development projects should go beyond traditional interventions in technical assistance, credit, and marketing, and should also seek solutions to the problems of health, shelter, education, and community organization. The need for integrated action was evident from a number of experiences: health care programs had been forced to consider nutrition, and were soon involved in production; literacy programs had been led into community organization, and from there into health, housing, and agriculture; production projects found their economic goals difficult to reach unless actions from other sectors were also included.

The interdisciplinary groups formed during this period went through many initial difficulties related to the lack of understanding among disciplines and

institutions. A common philosophy was not easy to achieve, and, even when agreement had apparently been reached, time and again it would break down as each sector tried to absorb more resources for its own agencies and plans of action. Many groups never passed this initial ordeal, but a few that survived succeeded in demonstrating some of the merits of integrated plans for development. In fact, enough excitement was generated in Colombia to lead to the adoption of a large-scale, integrated, rural-development project by the government in its plan to close the gap between the modern and traditional sectors.

The small group of professors who later established FUNDAEC participated in an interdisciplinary group at the Universidad del Valle and familiarized themselves with the work of a number of similar groups. As valid as the efforts of these groups were within an overall plan of development, they seemed only to present a better organization of the modern sector in order to study and understand the poor and, hopefully, offer them a few improved services. Multisectoral actions from the top, even when successfully carried out, at best give partial solutions to the basic problems of development. Coordinating agencies and bringing disciplines together are essential but far more important are plans organized from the standpoint of the inhabitants of a region and meaningful, significant participation of the people in their own processes of development.

Two Essential Elements of Participation

Concern with community participation is not new, and many development projects have incorporated its principles to some extent. Feedback, contribution in labour and kind, involvement in the detection of needs, and formulation of plans are examples of prevalent views on community participation. The orginators of FUNDAEC, however, tended to examine participation more within the context of the institutional capacities of a population and the organization of their common learning than in terms of the methods of dealing with segments of the population.

The group recognized that the differences in conditions of the modern and traditional sectors in Colombia go beyond simple disparity in economic capacity. The modern sector includes a large number of institutions that allow it access to political power, to information, capital, and credit, as well as technology and technical assistance. In the rural areas, little administrative structure exists. The channels for the flow of resources and information seem to end at the interface between the two sectors. Even the more successful development projects have had to manage their resources through the institutions of the modern sector and tailor their actions according to the structure of these institutions, which have experience in working only with successful farmers with large tracts of land. The full scope of the structural differences between the lifestyles of the two sectors is only slowly and painfully being recognized by these institutions. Thus, with a few exceptions, extension is planned according to the schemes successful with the large farmers, whose needs for assistance are specific, who can progress independently of their neighbours, who are usually better educated and have access to many sources of information, and whose net production at a given harvest is not necessarily crucial to other aspects of their lives such as the education of their children or the health care of their families. Largeholders have access to more than one source of credit, can sell their products to more than a single buyer, and often have investments in the marketing system. In all, they

participate directly or indirectly in a number of institutions from which they can choose a variety of services.

Far different are the conditions of the small farmers. They need both basic education and specific technical assistance. Their only capital is their smallholding, which does not attract credit from different sources. Their hopes for credit depend on the whims of official agents who visit them occasionally. There is little or no infrastructure on their farms and technological advances they may be aware of are not accessible to them. Their inability to choose sources of technical assistance, credit, and markets means that they must buy and sell at prices beyond their control. Above all, their destiny is inextricably tied to that of their neighbours; their village has to progress, to be educated, to have access to information, credit and technical assistance, and to develop its own viable organization.

The originators of FUNDAEC, thus, saw that the population's role would ultimately have to be defined in terms of gradual development of its institutions and organization. Most development efforts include some institutional development in their plans, often for the improvement of government services, for the organization of group production or marketing, or for channeling political pressure toward or against the existing government structure.

For FUNDAEC's creators, however, a second essential element of participation, almost as important as organization, was knowledge. How could a rural people claim to be in charge of their own development if they had no access to knowledge so easily available to other sectors, if they did not learn systematically from their own experiences, and if they did not participate in the generation, as well as the application, of knowledge accumulated at a global level? They perceived their first task, then, as the organization of learning and the first institution as one that provided education — an education almost equivalent to development itself. In fact, FUNDAEC was created to be such an institution, to become more than a school or university in the traditional sense and to involve itself in all aspects of community life, in an effort to bring knowledge to bear on the problems of rural development, examining them always from the point of view of the inhabitants of the regions it served.

The Institution

The institution that has evolved during nearly a decade has been called a rural university because of the level of its capacities, but, in fact, the word "university," with its traditional connotation, does not adequately describe the role that is assigned to it and the nature of the processes in which it is involved. Not only is this rural university concerned with education at all levels, but its role in the development of the region differs markedly from that of most institutions of higher learning. Many people believe that the educational sector contributes to development by providing individuals with specific skills and knowledge; they assume that somehow the existence of such individuals will by itself bring about development and give a country the capacity to maintain its pace. The institution described here, on the other hand, considers its main objective to be the search for strategies for development of the region it is to serve; training programs, the nature of which must necessarily change over time, are only components of the overall strategies. (In fact, FUNDAEC's rural university consisted of about 15 professors–investigators and some 30 students during its first 6 years. Only later

did the student population grow to several hundred as educational programs were established in many villages by graduates.) Some of the underlying principles and characteristics of the rural university are:

- Its professors and graduates make a consistent and continuous effort to develop an institution that belongs to the people of a rural region and try to understand development from their point of view. As a result, they avoid the danger of considering development as a product that is handed out to a people through a series of projects and interventions; they become more concerned with the long term. Although many processes are set in motion through interventions from outside, they must finally be managed by individuals and institutions of the region itself. Within this context, the participation of the population is not considered a mere methodology of community action but inherent to development.

- The members look for resources from outside the region in agencies and programs in charge of educational or health service, credit, extension, research, or the development of infrastructure, and try to attract them to the region. They take upon themselves the task of integrating the efforts of these institutions at the village level, a task that is essential even when integral plans are made at higher levels. In fact, they devote a great deal of effort to preparing local people themselves to coordinate such activities. In addition to integration of sectoral efforts, they try to provide continuity and permanence to the process of development. Many development projects that have achieved a certain degree of success, upon termination, have left rural populations with rapidly deteriorating conditions because of the region's lack of institutions capable of providing and sustaining the actions.

The rural university buildings.

• They see access to knowledge and participation in its generation as one of the most important elements of the process of development, and the lack of such access as a condition that opens doors to oppression. The first step in a development effort should be education to increase the population's capacity to use and generate knowledge for its social well-being. People require more than skills to share in development; manuals that transfer know-how — how to apply fertilizers or how to give an injection — are based on the assumption that decisions relating to rural development will always be made outside the region. More learning is required to equip people with the capacity to participate in basic decisions about their welfare. An inherent premise of the rural university is that people are not the problem, as has been assumed in many development programs, but rather the resource for bringing about change. Contrary to current conventional wisdom, educational investment at higher levels within a rural population is more efficient than at lower levels if it sets in motion a dynamic process for the development of human resources at different levels according to regional requirements.

• The educational system in Colombia, divided into levels with specific and inflexible functions, was designed in the modern sector to serve its perception of national interests. By providing training in particular skills to some segments of the population and offering opportunities for intellectual development to others, the system reinforces the gap between the traditional and modern sectors. Present disciplines and professions similarly reflect a division of knowledge that evolved in response to the needs of the modern sector in Colombia and elsewhere. By concentrating on the development purposes in the rural areas, the members of the rural university try to free themselves from the educational legacy of the past. They begin their educational activities with the identification of the characteristics needed to develop human potential for solving problems of the community at all levels. They then select the knowledge relevant for these purposes and integrate it in new ways so that individuals can comprehend it at different levels of competence. Curricula are designed for the rural peoples' needs and, when necessary, new disciplines are created. A constant revision of the educational content to address changing conditions is a necessary part of the educational process that parallels the path of development itself. By emphasizing the design of organization and content according to broad social purposes, the university transcends the conventional categories of formal, informal, and nonformal education; different educational approaches become complementary rather than mutually exclusive.

• The objectives of the rural university are stated in terms of setting in motion and catalyzing processes within the rural population that in their totality would form a lasting process of development. Among these, three types of activities are given special importance and great effort is made to carry them out simultaneously.

The first are concerned with the development of human resources. The corresponding programs cover education at different levels, using formal and nonformal methods, and their basic concern is the whole structure of personnel for the development of the region.

Training in itself, however, no matter how successful, will not bring about change. A second series of processes, concerned with the application of knowledge and the adaptation and propagation of technology are set in motion simultaneously. Many of the resources of the rural university are dedicated to the

gradual development of the scientific and technological capacities of the rural population. At present, research in the final adaptation of technologies is not carried out adequately because of the lack of institutions able to mediate between sophisticated international and national centres and the grass-roots organizations working with the traditional sector. The rural university is to fill this institutional gap and become an important element of the scheme for technological research.

Yet a third series of processes is related to the organization of the community. Organization, is conceived as more complex than simple group action and community projects. The whole structure of the community and the region, the services they offer, and the institutions and mechanisms that sustain social and economic activities at the village level are studied. Heavy emphasis is put on production, and channels for the flow of goods and marketing, for access to credit and the accumulation of capital, for the flow of information and technological assistance (without which increase in production and income is not possible) are improved or newly established. Within the context of this third component, activities in production become linked to training and research in technology, as these invariably are concerned with production.

- The total weight of development cannot be placed entirely on the shoulders of the rural population. The members of the rural university try to avoid the danger of assuming that the farmers by themselves can bring about a great deal of change. Even when all the necessary processes are in motion within a population, for decades to come, resources from outside the rural communities will have to be mobilized to fuel development. Although, as an institution, the rural university avoids political contention, it is clear, for example, that rural development is a meaningless concept if no land is available to the farmers. The existing separation between the modern and the traditional sectors — even when the government is willing to improve rural conditions — is such that intermediaries are needed to channel resources and make theoretical plans into operational realities. The professors and graduates of the rural university, therefore, take upon themselves the role of broker and try to attract and channel the resources of the modern sector. Without such activities, the graduates of the training program would be left with little to do, and many examples around the world show how training without subsequent opportunities for work and for bringing about change has led to frustration and has accelerated migration from rural areas to urban centres.

THE REGION AND PEOPLE

Not too many years ago, the Cauca Valley was considered a vast reserve of incomparable fauna and flora, so rich in beauty that the liberator Simón Bolívar was impelled to call it an earthly paradise. The travelers of the 17th century referred to it as the place where nature revealed the magnificence of its prodigy and the magic of its palette. A contemporary historian said: "Fragrant and crystalline, the Cauca Valley excites the senses; the soft contrast produced by light in its paradisical state, its refreshing breezes, the changing voice of its fountains, the potentiality of its low lands, its springtime sun, the emeraldine shine of its vegetation turn this land into an immense reserve of love and peace, of magical, crystalline and impalpable waters. This palpitating water color is one of the most beautiful outlays of God."

Norte del Cauca is at the southern end of the large Cauca Valley, 250 km long and 15–40 km wide. The valley extends from Cartago to Caloto and is surrounded by the occidental and central branches of the Andean mountains. Norte del Cauca consists of six municipalities — Caloto, Corinto, Miranda, Padilla, Puerto Tejada, and Santander de Quilichao. FUNDAEC has concentrated its efforts on these municipalities which lie in 100 000 ha of flat land or early foothills of the mountain range. The area is 1000–1100 m above sea level and receives an average yearly rainfall of 1000 mm.

Like so many rural areas of the world, Norte del Cauca is changing, and like most developing societies, is an ambiguous combination of contrasts: poverty and wealth, order and irregularity, continuity and instability, integration and disintegration, peace and frustration. It is another example of a society surviving in the empty space between the traditional and the so-called modern world, its inhabitants caught in the dilemma between what is and what ought to be. While fighting the constant battle for survival and for change without loss of identity, they try to remember how it was and ask themselves what they would like to accomplish. Many prefer to reside in the vague past: "When I was growing up, life was much better. Here, everyone owned a farm and a house. One could raise one's family well. We had all the food we needed, and one's neighbours did not have to sell, for the one who had enough would share. But the rich came and began to buy everything. Soon they started to knock down, knock down, and knock down the farms. Here, we will not have any food left. Everything will be finished, everything." Others, more hopeful, try to choose a way out. Although the way is not clear, they all have in mind the common idea of "becoming somebody." Maybe, the way to win and stop this constant battle is to study, to find a job, or best of all to own a large enough piece of land where one can grow one's own food and be productive.

"Becoming somebody" is the way most often chosen by the youth of the region. They spend their time switching between temporary jobs and studying. For most, being able to produce on one's land is a farfetched dream. The

inhabitants of Norte del Cauca continue with the processes necessary for their survival, while a series of forces from within and outside constantly influences their lives and, most of the time, limits their choices and opportunities.

One such force has been the rapid growth of the sugar industry. The expansion of sugarcane plantations has gradually left a great number of farmers without land. Wealthy landowners have persistently bought the land from the small farmers: "And so the sugarcane owners came here.... When someone said 'I am tired of living in these lands; the farm produces nothing; my neighbour is taking the water away,' the agents would call the sugarcane owners, buy the land right away, and begin to cultivate sugarcane.... Others, who had always had their farms, their little houses, and some money saved in the banks, would say 'I won't sell; I have no reason to sell'.... But you should remember that in this country we had the *violencia*...."

Over the past decades, this shift in land tenure has meant a continuous change in the occupation of the population, the change from farmer to farm worker. The landless farmers have been forced to search for work in the sugarcane industries, selling their labour cutting cane, sometimes on land originally belonging to their own families. Many of those who find employment in the industries, however, do not possess the characteristics of the modern industrial worker. The sugarcane cutters are contracted on a temporary basis through intermediaries and thus receive low salaries with no rights to insurance or social security benefits. When their contract ends, they have to search for a new way of survival.

Because of the lack of opportunities and the great force of poverty, the people of Norte del Cauca have become a transitory population in a state of constant temporary migration to the city. Those with more stability are the farmers who own *fincas*, where they usually plant coffee, cocoa, and plantain. There are also those who have permanent employment in the sugarcane industries or in large *haciendas* dedicated to raising cattle. The rest are in a constant search for jobs in the nearby cities, mainly in Cali and Popayán, and may even go as far as the eastern plains of Colombia for months or years.

Agricultural production in Norte del Cauca can thus be divided into three general categories. The first, in conjunction with agroindustry, mainly consists of sugarcane, soya, sorghum, rice, corn, and beans. Animal production on a large scale also exists in *haciendas*. The second type of production is that of the small farmers who grow coffee, cocoa, plantain, fruit trees, and perhaps some beans, corn, and cassava. The technology used in these farms is not adequate, and the level of production is low. The third kind of production is of families who try to produce some food for themselves and occasional marketing. Here each family owns 20–25 animals — chickens, turkeys, pigs, or ducks. These animals usually do not bring profits to the farmers, but, along with a handful of different plants, offer the family some cash and food in times of need.

The villages of Norte del Cauca are not self-sufficient units of production, and their population consists of producers of primary materials, mostly for the benefit of the modern sector. The residents of these villages are highly dependent on the existing markets in the nearby cities for the sale of their products and the purchase of necessities. The region is by no means the idealized rural area where civilization, with all its assumed benefits has not yet been able to reach; its inhabitants are integrated into the life of modern Colombia, especially the commerce and the labour market under the influence of the nearby city of Cali. It

is simply that the transition into modern life is not proving to be as beneficial for Norte del Cauca as everyone has been claiming. Life was probably not as good before as some tended to believe, but it has deteriorated and continues to do so at an alarming rate.

The Families

A look at one family in the region is worthwhile. The Zapata Abonía family consists of nine people — the parents, five children, and two grandchildren — and exemplifies the life of the local inhabitants. Don Alfonso, the father, is 50 years old. He was born and raised in La Arrobleda, has attained 3rd year elementary school, and has spent most of his time farming his own land. A few days a week, he earns extra money working on other farms, cleaning, preparing the land, or weeding.

Doña Edelmira is the mother of the family. She is 44 years old and has, like her husband, studied to the 3rd year of elementary school. She was born and grew up in San Rafael, which she left to marry don Alfonso. Along with housekeeping, she has always worked on the farm. At present, however, due to problems she has had with varices, she can only attend to a few animals, 15 chickens, 5 hens, and 2 pigs.

Their eldest daughter, Carmen, is 23 years old and works as a maid in Cali. With part of what she earns (3000 pesos/month), she pays for some of the expenses of her two children whom she has left in La Arrobleda with her parents. Ricardo is 7 years old and Luz Elena is 5. This coming year Carmen will send Ricardo to school. Carmen, herself, has studied up to the 1st year of high school and also knows how to sew. Every 2 weeks, Carmen comes home to visit her family with 1000 pesos and some groceries. (In December 1980, when this description was written, the exchange rate was about 50 pesos/US$1.)

The eldest son, Hugo, is 20 years old. Like don Alfonso, he works on the farm and outside, usually on the sugarcane plantations. He earns 180 pesos/day and works an average of 10 days a month. Hugo completed 2 years of high school traveling to Puerto Tejada every day.

Lucila is 16 and is studying in the 2nd year of high school in Caloto where she lives with her aunt. She comes home on weekends, supplying fruit, eggs, and, sometimes, a chicken to help with the expenses. When Lucila is at home, she spends most of her time organizing the community. At present, she is organizing a group to bring an aqueduct to the village. She says that she wants to finish high school and pursue a career in health care or education.

Arcadio and Luis Alfonso, 13 and 12 years old, are in the 5th and 4th grades in the elementary school of the village. They stay at home periodically to help their parents with the farm work when they feel they are needed. In general, the children are in good health.

The Zapata Abonía family owns the home in which they live, which is 100 m^2 and consists of three rooms besides a living room and a dining room. One of the rooms is being used for storage and the other two are bedrooms. The house is adobe, and the roof is tile. The floor of the dining room, living room, and the halls is concrete, whereas the floor of the rest of the house is earth. The house has good ventilation — a 90 × 90 cm window in every room. The *patios* cover an

area of 42 m^2. The water jar, always covered, is kept in the kitchen. The pigpen is located 6 m away from the residential building and is tin with an "eternit" roof. Beside it is a piece of canvas used in the drying of cocoa and coffee. Constructed 4 years ago, the bathroom is 20 m away from the house. It has brick walls but still lacks a floor and a roof. The cover is tin and is unstable. The water well, which is 7 m deep and has a diameter of 80 cm, is 25 m away from the house. It is kept covered except when the family, using a bucket, withdraws water. The well dries up during the summer.

The family owns two shovels, a hoe, a machete, and a cart, all of which are kept in the storage room. Currently, the chickens sleep in the storage room, but, don Alfonso is considering building a chicken shelter when the harvest is sold. The property owned by this family comprises two half-plazas (one plaza = 6400 m^2) in La Arrobleda and one half-plaza in San Rafael. Don Alfonso inherited the land in La Arrobleda from his parents, and the piece in San Rafael belongs to doña Edelmira. The family grows corn, field beans, and soybeans on one half-plaza in La Arrobleda, rotating the crops every 6 months.

The other half-plaza in La Arrobleda is rented to a machinery owner in exchange for land preparation of the family plot once every semester. The land in San Rafael is a *finca* where cocoa, coffee, and some fruit trees are grown.

Annual production is corn, 4 bags of 5 arrobas (1 arroba = ca 12 kg); beans, 4.5 bags of 5 arrobas; soybean, 9 bags of 6 arrobas; cocoa, about 7 kg per harvest (two/year); and coffee, about 2 arrobas per harvest (also two harvests/year). Besides what the family consumes, the *finca* produces a few hundred oranges/year, about 200 guavas, 50 avocadoes, and 200 maracuyás.

Like the majority of the families of the region, the Zapata Abonías wish to move forward. How is not clear. They want their children to finish high school and keep their love for the farm so that some at least continue to produce food.

Doña Edelmira, according to her doctor, needs an operation for her varices. It is the only way she can resume farmwork. Lucila and Hugo's aspirations have to do with studying. At present, Hugo is interested in the courses offered by FUNDAEC and has started working with the rural engineer of his zone. He plans to form a study group with the youth of the village who, like himself, want to study but have never had the opportunity to do so.

Arcadio, who will finish elementary school this year, is thinking about entering high school in Caloto. Carmen would like to see the establishment of a kindergarten or something similar in the village. She wants her children to learn more through new methods. Where she works in Cali, she has seen how much children younger than hers can learn in these schools.

They all have one common, immediate goal: to improve the house. More than anything, they wish to fix the bathroom and enlarge the well. They believe that, when they resume control of the piece of land they have rented out, they can improve the house and their farm in San Rafael. Don Alfonso has made contacts to acquire a loan from the Caja Agraria through which he hopes to be able to produce some crops on the land.

But the family is thinking not only of itself. They also have dreams for their community. They would like to see the village more united to accomplish common goals. They also believe, from their few contacts with FUNDAEC, that the existence of an engineer in rural well-being can change things in their village.

The Students

Guachené, with about 3000 people, is one of the larger villages of Norte del Cauca. There, on a hot afternoon late in 1974, two of the founders of FUNDAEC sat in the large living room of doña Edelmira with a group of 10–15 young people talking about the new educational program they planned to start in the region. They had done little to attract the youth: one of the group had simply gone to the village a few days before, had mentioned the ideas to a few young people, and had asked them to arrange a meeting.

The professors explained that they wanted to measure the degree of difficulty of some of the materials being designed. The subject chosen was mathematics, and, since no one in the group had ever studied algebra or worked with the concept of equations, that is where the professors began. The idea was to teach each group new concepts and see how quickly they learned. The presentation went like this:

> Suppose that you want to find out how many girls are in a given group. Someone tells you that there are three boys in a group of 10. How many girls are there?
>
> Suppose that you want to know how much space you have along a wall without doors and windows. You measure the length of the door and the window together and it turns out to be 3 metres. You know that the length of the room is 10 metres. How much of the wall is free?
>
> You want to know how much you spent today. You search in your pocket and find 3 pesos and you remember starting with 10. How much did you spend?
>
> Now these are very simple questions and you all quickly gave the answers. But let us think a little: can you see any similarity among these problems? Would it be right to say that they were all the same problem? Actually there is a way to summarize all we have said by writing what is called an equation, in this case, $x + 3 = 10$.

Normally, the professors would have continued conversing with the group along these lines, would have given them examples of different equations, and would have asked them to give their solutions. Everyone would do equally well until asked whether $a + 3 = 10$ and $x + 3 = 10$ were the same equation. Then, the different capacities for abstraction would begin to emerge, and by increasing the degrees of generalization, the professors would slowly develop a feeling of the mathematical aptitude of each member of the group. On this occasion, however, there was a surprise in store. Right after the concept of an equation was introduced, three newcomers joined the group. The professors asked whether someone would explain what had been discussed. Parmenides volunteered and proceeded to use different situations, different numbers, and different symbols to describe what he had just learned.

Parmenides was 17 years old and, many years earlier, had been suspended from primary school for his temperament. He had never finished primary school, nor had he participated in any courses or programs of formal or informal education. He was working at the time as an agricultural labourer on a small farm near Guachené. He was selected for FUNDAEC's program.

Selection, however, was based not only on mathematical aptitude but also on

other capacities and attitudes related to learning in general and to service to the community. Each group interviewed had its own surprises, and FUNDAEC's organizers knew that the students represented a rich mine of talents, and that they were embarking on an exciting educational experience.

That the professors had to select a small group of students was, in a certain sense, irrelevant to their basic assumptions about education. In an appropriate educational atmosphere, everyone learns, although at different paces and with different intensities. The professors recognized that there were hundreds of youth who could go through the intensive educational experience with success. They undertook careful selection in response to many factors — among them, their resources and the desire to prove that youth from a rural community could quickly reach high levels of proficiency in a totally different education system. They wanted to make a point: all through their contacts with well-meaning development groups, they had consistently perceived an air of doubt about the real capacities of the poor, especially those living in the rural area. Said in many subtle ways, or simply implicit in the way activities were planned and carried out, there was always the implication that poverty was more than the lack of material means. Whether because of malnutrition, lack of stimulus, or cultural factors, the poor were being treated by development personnel as if they were less intelligent when compared with the rest of humanity. The professors of FUNDAEC wanted to establish a different experience and to present the world with a different statement. Parmenides as well as the other students involved in FUNDAEC may never have received a full daily requirement of protein as recommended by fashionable theories or the kind of stimulus available through the educational-technology business; yet, they have certainly proved to be intellectually developed young adults and dispel the image of the poor farmer whose life has to be planned and managed by the more privileged members of the human race.

INVESTING IN HUMAN RESOURCES

In 1974, during early deliberations on the nature of the educational aims of the rural university, it became evident that the skills, instruments, and disciplines of traditional universities were not directly applicable to the conditions of the rural areas: they addressed a reality of other societies and other historical situations, with careers and professions being chosen on the basis of academic tradition rather than an analysis of social needs. FUNDAEC's founders felt that the natural, all-embracing structure of knowledge had been obscured by its division into disciplines, each of which had developed its own social concepts and ideology. The single-discipline approach to rural development was clearly counterproductive, and, to the professors of FUNDAEC, a superficial interdisciplinary style did not seem to constitute an alternative.

The founders of FUNDAEC had lost faith in traditional rural training and in the attempts at curriculum reform within the existing structure of disciplines. They began to envision, as the first and most central responsibility of the rural university, the establishment of long-term research and action through which one could constantly identify related problems and opportunities in the region, establish the characteristics of the human resources capable of confronting these problems, and design and teach curricula for the development of the necessary personnel. They decided that FUNDAEC's programs and corresponding curricula would change as the population advanced along its path of development and would help to shape, at any given moment, the human resources according to the best available knowledge of social needs. They also decided that social needs would be identified in the context of a constant search for new insights into human nature and aspiration and not in terms of theoretical models of preconceived political systems. The educational programs would not be utilitarian in nature but would address fundamental intellectual and spiritual issues, not only of a single individual but also of a community.

This approach eventually led to a program for the training of individuals at three levels — promoter, technician, and engineer in rural well-being — capable of working directly with rural families and able to coordinate the efforts of different sectors to ensure integrated rural development. It involves a tutorial program for the training of promoters at the village level, a combination of formal school and a tutorial program for technicians, and a formal 3-year program plus at least a year of supervised residence in a village for the training of engineers. However, the activities initiated in 1974 did not involve the first two levels and concentrated on the education of a first group of engineers, who together with their professors, would later set in motion the different development processes in the villages, including the gradual formation of the pyramid of workers in rural well-being.

The task of creating an institution of higher learning within a rural area clearly could not follow traditional academic concepts. In most rural regions, it is

difficult to find sufficient numbers of high-school graduates, and the low quality of the few existing secondary schools makes attending a university, for the vast majority of the youth, an unrealistic dream. To have waited for a total reform of primary and secondary schools before higher education could become accessible to the rural population would have contradicted the desire to break away from the increasing tendency of programs to offer rural populations nothing more than skills to carry out technical instructions. The challenge was to establish a dynamic, educational process different from the rigidly structured primary, secondary, and university education. The professors saw this as a possibility if a number of youth could be helped to develop, quickly, some of the capabilities of a university student.

An analysis of the existing educational system convinced the FUNDAEC professors that an innovative, preparatory program could be designed to help selected youth with special aptitudes, regardless of their schooling, to reach university level in about 2 years. That enough rural youths with the desired aptitudes existed to justify a program of this nature was a hypothesis that the experience of the next few years amply supported. The age group of the students with which the professors would work is one of the most disoriented and easily discouraged, and the task of turning some of its members into the first catalysts of change was laden with difficulties. However, rather than concentrating on easier goals, they decided a rural university should begin by confronting this basic challenge of rural education.

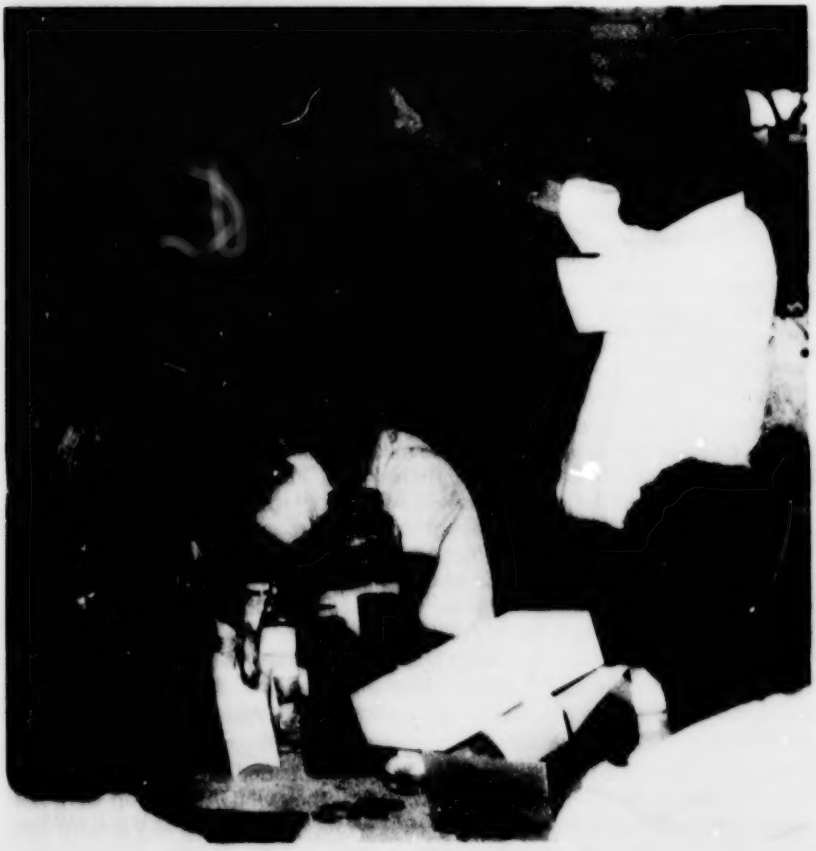
By May 1975, 26 men and women, aged 16–23 had been selected on the basis of their learning abilities. In spite of the fact that some of them had previously completed only 4th year primary education, they demonstrated, in the next few years, an enormous capacity to learn the content of the courses. Independent of what the future holds for FUNDAEC in the development of the region, there is a consensus among the participants that the educational program has been successful and has offered a most exciting and fruitful learning experience.

The decision to create a program for the training of a new professional, the engineer in rural well-being, was based on the professors' view of the possibilities for social change rather than as a response to the labour market. In fact, the mode of operation of the future graduates and their possible sources of income were to be defined as FUNDAEC succeeded in setting in motion a series of development processes within the population of the region. Under these circumstances, to describe the desired characteristics of the graduate and to establish the corresponding educational objectives represented a difficult challenge. Task analysis has often been used to determine the objectives of training courses, but it is a method more suited to reform of curricula of existing careers. FUNDAEC's creators intended to do far more than reform; they hoped to develop a new field of action, searching for the content of a truly rural education.

Faced with the inapplicability of current methods of curriculum design, the group finally decided to define the curriculum by general category only, concentrating on the creation of content as well as objectives through a series of consecutive approximations. They felt the recent fashion of defining educational activities in terms of narrow and precise objectives, in general, was unsuitable for their endeavour: the learning could not be rigidly programed. The professors wanted to avoid limiting, a priori, the capacities of the students; quite often, at the end of an activity, they confronted the students with situations as yet beyond their learning capacity and knowledge. Years of teaching experience had shown

the FUNDAEC professors how their conventional university students, accustomed to comfortable definitions and well-defined situations, were at a total loss when confronting the complexities of the search for new knowledge or when looking for solutions to problems under real conditions. Besides, the FUNDAEC professors were process minded and were rebelling against what they considered to be undue emphasis on hypotheses and objectives — the narrow interpretation of the methods of science. They were determined to pay attention to the art of teaching as well as the science of education.

To define the general categories and divisions of the desired curriculum, the professors began by analyzing the content of the Colombian educational system and examined existing texts, especially those widely used in the high schools. Their findings convinced them that the system, in addition to being socially irrelevant, was failing its pedagogical objectives as well. The educational program's goals were to endow students with appropriate concepts, skills, capabilities, and attitudes, as well as to impart facts and information. The existing system had seemingly concentrated on presenting a succession of facts and formulas and had succeeded in developing, at best, a few useful skills in the students. The



Teaching science to promotors.

FUNDAEC professors decided, then, to structure the new curricula in terms of concepts and capabilities rather than simple skills and information. In fact, they overemphasized concepts during the first years, with the resultant criticism that "philosophers of rural well-being" (probably a respectable profession in its own right) were being trained rather than practical workers. The curriculum was then revised to gain a more desirable balance between facts, skills, and concepts.

The professors finally agreed that the concepts and capabilities necessary for a generalist worker in rural well-being fell into five basic categories: mathematics, sciences, language, crafts and technology, and service to the community. The categories do not cover the whole spectrum of possible human capabilities but the rural engineer was to be only one of the professionals working for the improvement of rural well-being.

The FUNDAEC curriculum evolved but never changed its emphasis: the in-depth understanding and development of the students' attitudes and capabilities. The reward was highly accelerated learning by the students. Many educational programs, including modern attempts at reform, lack this emphasis and are a symptom of the gradual disappearance of the human being as the basic concern of planners and planning offices. Hundreds of vague indices and numbers, measuring input, output, and efficiency, can be registered on paper and tapes; machines can be made to do things and increase the efficiency of a system; but attitudes and capabilities have to be developed in human beings.

Form and Content

How to impart their educational message also concerned the professors. Educational technology was in vogue at the time, but the FUNDAEC group felt that there was too much emphasis on form rather than content. The textbooks used in the Colombian system had become more colourful during the previous decade. Convenient formulas and conclusions were presented in neatly arranged boxes on the appropriate pages. In schools of education, courses were being taught in the use of audiovisual gadgets, programing, and organizing time and space. Above all, everyone was learning to formulate objectives. The objectives that were being formulated were excellent and based on the most advanced educational theories, yet the message, the content of the educational material, continued to be the same. There was no correspondence (and there is still none) between the most impressive set of objectives for the education of children and youth and what is taught in the classrooms in Colombia. As far as rural education is concerned, the content is urban, dogmatic, fragmented, rigid, and superficial. It dissociates the students from nature and the reality of their surroundings, includes few social, moral, and spiritual teachings, and contributes little to the development of creativity. No matter how much technology is used in presenting this message, it continues to lead to rote learning, to superficiality, and to intellectual boredom. Within this context, it was imperative that FUNDAEC dedicate itself to the search for new content, even if the form continued to be traditional.

The decision not to introduce many modern educational aids into the program was not a rejection of educational technology. The FUNDAEC group were not denying the usefulness of technology; they simply asserted that the form followed the content and was not an end in itself. In fact, almost a decade later, once the innovation in content has proved successful, FUNDAEC's staff are

beginning to look for technology to make their system more efficient and capable of serving a larger number of students.

The changes in form that were brought about were mostly related to the teaching–learning experience itself. The search for a valid rural education implied changes in the relationships between many of the elements of the educational system — time, space, students, teachers, school, and the community. For example, the relationship between the students and the professors at FUNDAEC was one of co-workers embarked on an enterprise of great importance — the search for the path of development of their people. The student was not considered an empty container to be filled drop by drop but a mine of hidden talents and potential that needed to be discovered, perfected, and directed toward the service of the community. The method of teaching, reflected in the design of textbooks, was one of raising questions and trying to find answers in an atmosphere of consultation between teachers and students.

The principle of participation, so essential to the concept of FUNDAEC, governed the educational activities as well. Participation was treated as a process to be achieved as the students develop their capacities. Democracy for its own sake was not given importance. The purpose was to increase participation without denying the special position of the teacher who has access to much more knowledge in a specific field than the students. The teacher's role was to guide the students through the exploration of knowledge. During this exploration, students and teachers definitely do not have equal status. Yet, the authority is thought to be that of knowledge and not of the person of the teacher, and everyone is taught that the authority of knowledge is not absolute either.

The first step to achieve participation is to convince the students that the weight of the teaching–learning experience is on their shoulders; they, not the teacher, should be the active agents. This is not an easy task in Colombia and, for youth who have had contact with the educational system, involves unlearning a number of negative attitudes and customs. The whole context of FUNDAEC, however, has proved to be extremely effective in helping to achieve this first step. Once achieved, this attitude allows students to move quickly to active participation in planning, elaboration of schedules, supervision of activities, and revision of content of the courses.

Integration

Many of the principal characteristics of the efforts of FUNDAEC in its first decade have been, in one way or another, related to the concept of integration. In the early years, the group was trying to add new elements to the concept of integrated development; thus, in education, one of the central issues was integrated curricula.

Attempts to create integrated curricula were, of course, not new and the professors who established FUNDAEC were aware of many that could be characterized as trying to bring together knowledge pertaining to different but related disciplines. In general, the approach has been to choose a discipline, an activity, or a theme as an axis around which a unit of instruction is prepared. The reasons for this kind of integration seem to be pedagogical and are based on assertions implying that a child learns more if reality is presented in an integral way, that an integrated course of science achieves more than one divided into

separate disciplines, or that it is clearly better to teach history, geography, and other related subjects together. For FUNDAEC, the issue of integration was more essential than its implications for the enhancement of learning; it was to be a key to solving a number of conceptual and practical problems.

The division of knowledge into disciplines has been given undue importance in this period of human history marked with technological progress and increasing specialization. In a certain sense, the division into the present set of disciplines is seen as inherent to knowledge itself, which is defined in terms of its fragments, as a sum of all the disciplines in natural and social sciences, arts and humanities, and professional fields such as engineering or medicine. Yet, knowledge is a whole and its division into disciplines is nothing more than a result of the finiteness of the human mind. The choice of divisions, however, is not a consequence of pure human thought and meditation; it is strongly affected by ideology and social conditions. The way a Western university is organized in departments dealing with defined disciplines reflects a style of life, a social ideology, and historical realities of a people, as well as being a convenient division of knowledge to be grasped by individuals of different talents and inclinations. Therefore, when a population establishes such a structure for its educational system, it is buying more than knowledge; it is making definite statements about its future social organization.

In practice, the Western structure of specialized training is facing a crisis as it tries to solve the problems of the developing countries. The most conventional answer seems to be the creation of interdisciplinary groups, the adding of experts to form a wider field of expertise. As useful as this may be, it is only a partial step toward integration and is not an answer to the problems of the fragmentation of societies reflected in their defective educational systems.

The frontiers of disciplines, of course, are not fixed in materially advanced societies where modern university models are originating. When new problems emerge, often new disciplines are created. However, seldom is the movement toward integration and generalization. The tendency, with few exceptions, is toward concentration on narrower and narrower problems and fields. At a philosophical level, one could argue against this tendency and relate it to some of the evils of modern society, but, at the time, the individuals forming FUNDAEC were not concerned with such arguments: they were trying to face concrete problems and issues. The curricula taught at the universities in Colombia — transplants from universities in other countries — were not preparing individuals to be capable of solving the problems of the small farmers or, for that matter, any other section of the majority of the population of the country. The graduates of these universities were taught to function within a different society, which was presumably being built through the process of modernization, but to which only a small minority could belong. To the organizers of FUNDAEC, it was clear, then, that new curricula should not be developed from sums of disciplines of professional programs designed for other social realities.

The approach finally adopted was to give a broad meaning to the concept of integration in curriculum design: to define it as a process fusing relevant elements from the universe of knowledge for programs of education with a definite and clear purpose. The purpose in itself was not to be based only on pedagogical considerations; the curriculum should be integrated to support a social purpose. FUNDAEC was founded for the specific purpose of improving the well-being of local communities; the same purpose became the basic guide for curriculum

integration. The axis around which an integrated curriculum would be built, then, rather than a theme, activity, or a subject matter, was service to the community. To be involved in organizing knowledge in teaching programs relevant to the real conditions of the people, the FUNDAEC group realized that writing and rewriting the curricula would be among the most important tasks as conditions change.

An educational program with a definite and explicit social purpose creates an atmosphere radically different from the one in most educational systems. The purpose encourages activities that integrate and apply knowledge and, therefore, motivate and facilitate learning; it also shapes the attitudes of the professors and the students, creating a mystique. Although, in FUNDAEC's system, the students and teachers are still interested in improving their social and economic status, this desire decreases in importance and occupies its proper place within a far greater social context. To assert that professors and students of high schools and universities do not have positive social attitudes, and attribute much of the educational crisis to lack of motivation, may be valid for many countries. However, such an assertion must be analyzed in light of the relevance of education and the fact that the programs offered in most educational systems do not contain any valid social purpose.

One of the greatest shortcomings of educational programs is their inability to bring together practical and theoretical knowledge, to unite conceptual capacities with specific skills. Current education programs provide practical and manual skills for some, book-learning for others, training to carry out orders for the majority, and the capacity to participate in planning and decision-making for the few. The FUNDAEC concept was to maintain the interest of a student in skills such as raising chickens and learning plant and animal physiology, economic theory, or thermodynamics.

The program that evolved is a successful initial step in integrating theory and practice. The social purpose of the program and the constant reference to the real problems of the rural communities have helped to place things in perspective. Prejudices and a false scale of prestige have slowly disappeared and a single purpose of learning what is needed to reach specific social goals has taken their place.

Finally, the FUNDAEC founders were searching for a curriculum concerned with the students' inner conditions because within the human soul social and moral disintegration is producing its most devastating effects. The sophisticated terminology being used in different disciplines to refer to human behaviour seemed to the FUNDAEC group to be an attempt to avoid facing an essential and old issue: are humans simply animals, full of selfish desires, whose behaviour is already determined by the laws of the material world? Or do they (we) possess a nature that, if developed, would free us from ego and bring forth noble characteristics? The two most cherished fruits of the first view in this century have been the consumer society on the one hand, and slavery to the state under a totalitarian regime on the other. To rebel against these and identify FUNDAEC as a spiritual movement was easy but what this meant in practice was not so straightforward if they wished to go beyond the level of customary rhetoric.

In the field of education, human and moral development has been neglected; while hundreds of experiments have tried to discover how to teach a child a mathematical concept or a scientific fact, few have looked for educational activities that lead, for example, to integrity, social responsibility, or rectitude of

conduct. The portions of existing curricula designed to edify human character contribute to fragmentation, as they separate the discourse on the inner conditions of the individual from every other aspect of importance in life. Materialism, a most fanatic and intolerant religion, has continuously driven spiritual issues farther and farther away from the mainstream of intellectual activity. Education is materialistic (even in the case of some religious institutions), and educators have given lip service to "human development" in isolated courses of dogma, ritual, or ethics. But, in most societies, propaganda is the strongest force shaping the human character, whether it comes from the producers of goods and services or from dominant political parties. The community of educators, in its great zeal to become "scientific," has been preoccupied with psychological games and the application of sophisticated technology.

In FUNDAEC, attempts were made to integrate spiritual concepts in the curriculum and a number of important lessons were learned. The curriculum that was created did not include a course in religious dogma or its humanistic counterparts — ethics and social behaviour. Spirituality was treated as a state, an inner condition that should manifest itself in action, in everyday choices, in profound understanding of human nature, and in meaningful contributions to community life and to society. It was to be integrated into every educational activity; every activity was to be a context for the clarification and application of its principles. It constituted the context for the entire educational system. Within this context, service to the community became the practice of spirituality but was carried out in freedom. A concept that continuously gained in importance throughout the years was that of balance: for example, balance between personal liberty and social obligation, between being the teacher of nature and living in harmony with it, between using natural resources and being concerned with their conservation. The balance between humanism and science — the physical and spiritual, rational and emotional — was to be the greatest challenge, for it was the basic issue underlying the entire process of integration. Years later, outside observers would credit FUNDAEC with having faced this challenge well, but the original group, even more aware of the extent to which social and moral disintegration has advanced, would look at this aspect of their work with a feeling of impotence and bewilderment.

Program of Rural Well-being

When the first group of students entered the program, the FUNDAEC founders had formulated vague concepts that would take almost a decade to crystallize. They hoped their plan would work but did not want to join the ranks of people who had entered the development game, created institutions, and survived using the ever-worsening conditions of the poor as a rationale. They considered the 1st year of the program as crucial and said — probably too emotionally — that if the results were not unique, they would dissolve FUNDAEC immediately. They were relieved when, from the first months, the majority of students learned at a pace that surpassed expectations.

With the second group of students, 2 years later, they paid even more attention to actions in the community, trying to determine the extent of their capabilities as agents of change after 1 year of education at the rural university. They compared the students with agents of government programs, especially the health promoters who, in Colombia, received about 3 months of intensive training in

primary health care. They observed that their students could learn the skills of a health promoter without special training in FUNDAEC, and their understanding of the issues of community health was superior. The FUNDAEC students had the added advantage of understanding the issues of education, production, and community organization. Thus, the organizers seized upon the idea of training a promoter of rural well-being.

Promoters

Initially, they conceived the promoters as polivalent agents who could replace, for example, the health promoters within the government services. However, health promoters and other agents working at this level constitute a negligible portion of the population of a region, one or two people within each village. As the FUNDAEC group envisioned the promoters as the foundation — the first level of a pyramid — they wanted to reach a larger proportion of the young population. Basic education became the focus, preparing promoters within the context of universal education. No one can deny the right of children to learn to read and write, to carry out arithmetic operations, and to manage rudimentary information about nature and society. To these requirements of basic education, FUNDAEC added specific skills in agriculture, animal husbandry, industry, or even health or social work to enable the young villagers to earn a livelihood as well as to serve as a basic human resource for the development of the village. Promoters ceased to be looked upon as paid workers and came to be regarded as the product of a basic education. The Ministry of Education accepted the curriculum as equivalent to 2 years of high school, although some evaluators considered it closer to 3–4 years, and the organizers in the rural university began to experiment with methods to make this education available to an increasing number of young people throughout the region.

The FUNDAEC group assigned values (points) to the concepts within each lesson, and the activities, skills, or abilities resulted in a total of 450 points required to complete the promoter course: service to the community 120, mathematics 75, science 70, technology 55, and language 130. The engineers enter into an explicit agreement with interested youth in a community to establish a number of teaching–learning activities according to the capabilities of the students and the time available for studying. Teaching–learning activities have ranged from formal classes with 15–20 students a few nights a week, to individual tutoring for students who advance rapidly and only need one session a week to discuss the material already studied. Even in the formal classes, attention is given to small groups that advance uniformly, and traditional ways of "giving a class" by the teacher are avoided. The students then advance according to their individual potential, accumulating points on a monthly basis. They receive credits in evaluations during weekend seminars by the professors of the rural university. The seminars maintain a flow of students through the system, with graduation of promoters at a rate of about 20 per cent of the total number of students per year. A few students finish the 2-year equivalent of high school in 1 year; many advance at a slow pace. By definition, the system has few dropouts; the slow students require little from the system and the cost of maintaining them is negligible. FUNDAEC, throughout the years, has been criticized for the high cost of education of a rural engineer, mostly by hasty observers who divided all costs, including those of research and the development of texts, by the number of students. The cost of training a promoter in the tutorial system, including the

time of the engineers, the value of six textbooks, and the necessary administration by the rural university with a student population of about 200, is about three-fourths of what the official system spends to send a student through the first 2 years of high school.

The Curriculum

Students with high aptitudes can complete the promoter course in 1 year. The program tries to develop competence for specific actions and dedicates much effort to the development of basic capacities, which not only allow the students to continue their education at higher levels but also facilitate the move into the official educational system.

In mathematics, students review arithmetic and learn to apply it. The object is to develop in them the capacity to work with numbers and quantitative statements and to instill in them a clear understanding of basic concepts. They study classification of plants and animals as they review the concepts of sets; to practice addition and subtraction, they learn simple bookkeeping; they learn to measure and approximate as they review the structure of the decimal system; as they practice simple mathematical operations, they analyze data from experiments in adaptation of technologies (such as the comparison of different diets for raising animals), and they study indices related to the health of a population as they study fractions.

In language, the students read passages on subjects related to their future work. Some of these passages are transcripts from recordings made with the inhabitants of rural areas. Thus, while they improve their reading and comprehension, they also acquire an understanding of the problems of communication, as they analyze language and different modes of expression. Also in language, they begin a series called "Descriptions," in which they systematize concepts and learn words and expressions to describe the world that surrounds them: objects, human beings and their qualities, systems, and social processes. They are asked to write descriptions of a few families while working jointly with them and analyzing their needs, their resources, and their aspirations.

Science is not taught in the context of disciplines but through the study of systems and processes of nature. The students are guided through a sequence of scientific activities, choosing the systems they need to study to increase their understanding of a selected process, making observations, studying texts about the process, organizing their observations, experimenting, and making models to explain what they have learned. At this level, they study the changes in a population of an insect, vegetative growth (in a small field of corn and beans), the transfer of heat, the transformation of energy in a simple electrical circuit, and photosynthesis.

Encouraging competence in skills of production is the approach taken for technology courses. For example, a series of lessons guides the students through the cultivation of small areas, with association and rotation of about five crops, as part of a larger diversified system. A second series of lessons is concerned with the promotion of simple techniques to improve the raising of chickens.

Community service is concerned with diagnosing the conditions of rural families and identifying opportunities and resources. The students are expected to strengthen their relationships with a number of families in their village and to consult continually with them. Groups of lessons in class try to give the students

Science is studied through the processes of nature.

the concepts and instruments that facilitate consultation and observation. Simultaneously, certain skills and information, especially in health and education, are shared with the students, so that they do not become mere observers but can actually offer help with simple projects of literacy or health education. Throughout the course, health, technology, social services, the organization of production, small industries, marketing and the purchase of goods, the structure of organized groups, and education are studied as essential aspects of a total view of the village and its material culture. At the end, the students are asked to describe, in detail, their diagnosis as well as observations, consultation, and action. A review of the other tests during the last classes of this course permits an analysis of the possible application of the knowledge acquired by the promoter to help improve the conditions of the village.

Technicians

Candidates — promoters — to become technicians continue their training following the same line of activities. For selected students, this training lasts 2 more years. In a nonformal system, time can be adjusted to the capacities of each student, and, within the official system, it is considered equivalent to the last 4 years of a high-school program. The curriculum contains the same five basic areas of competence. In mathematics, a series of texts, always related to practical applications, helps the students reach a first course in calculus. In language, they read and continue "Descriptions," to increase their capacity to extract useful information, to observe, to describe, and to communicate. Science is also a continuation of earlier studies, and, by the last two units, they have begun studying university-level subjects. Their training in technology gives them

the skills to participate in projects and experiments, to look for solutions to the region's technological needs in agriculture, animal husbandry, construction, or mechanical instruments.

Community service expands into a more complex set of activities. It becomes organized into research–action–learning packages. For example, in a package concerned with environmental issues, the students analyze the state of sanitation in a village and relate it to the health status of its inhabitants. In a package called "Small units of production," they begin small production projects with one or two families, apply their technical skills, and receive their first training in simple economics and community organization. Another package (called "Normal development of a child") teaches them educational and health concepts and helps them to carry out a number of educational projects with the village children.

Engineers

Technicians can go on to become engineers, with 3 additional years of formal education and 1 year of supervised residence in a village. Their curriculum includes two different outlooks: they receive courses in specific disciplines, and, at the same time, courses that integrate knowledge and apply it to the problems of the villages. Research–action–learning packages in health and sanitation, education, production, and community organization are complemented by specific courses in related disciplines, training recognized to be equivalent to that of a university graduate. Their knowledge of agriculture should allow them to function effectively in finding solutions to the production problems of the small farmers. In addition, they can analyze the problems of community health and can mobilize resources for their solution. Moreover, they are on their way to becoming community organizers and educators.

It is unrealistic to hope that none of the youth participating in this program will be caught up in the process of migration from rural areas to the cities. Nor is it desirable to establish a program with the aim of keeping the young forcefully within one or another sector of society. However, it is important to note that for many youth the attractions of the city are not among the most important factors that lure them away from their villages. The lack of alternatives for work within programs that are fulfilling, on the other hand, is an essential reason for migration. Therefore, the fact that the rural university goes beyond training individuals and tries to establish an integral development strategy becomes important. It is hoped that the actions of the university will lead to exciting work opportunities different from those of traditional leaders, village workers, or change agents. While collaborating with existing efforts, and even, when necessary, deriving part of their livelihood from government programs, these workers in rural well-being are taught to see themselves as belonging to the rural community itself, bringing resources and integrating efforts at the village level; they are expected to realize that their own fulfillment lies in the establishment of a widening community base for learning and participation.

APPLYING SCIENCE AND DISSEMINATING TECHNOLOGY

From the first months of the rural university, choice of alternative technologies was a topic that occupied a position of special importance. A large number of technical needs were perceived from the mere contact with rural families, and known technologies, judged by their performance, were clearly inadequate. In agricultural production, during the first 3 years, FUNDAEC worked intensively with a few families of the region, first using the latest technical packages from the international and national research systems, and then following the conviction that the small farmers' own traditions were best for the specific environment. By 1977, humbled by its failures, it entered a stage of careful experimentation and reflection to build a less simplistic framework for future activities.

The Concept

The opinions that have guided FUNDAEC in its technological endeavours have varied between extremes — between those who argue that the necessary technology already exists or is being developed in international and national centres and only needs to be properly disseminated, and those who reject modern technology and try to seek solutions in the traditions of each rural region. Depending on political ideology, the former either advocate total change of the political system or ask that all resources be poured into strengthening the present structure of government services, which, they assert, will bring modernization and the efficient use of modern technology to the villages. The latter, on the other hand, tend to romanticize the past and try fruitlessly to recuperate it. Between the extremes are many conceptions of appropriateness based on cost, participation, relation of labour and capital, accessibility, softness and hardness.

Faced with these diverse opinions, each with a logic of its own, the members of the rural university finally decided to avoid definitions based on methods and products and focus on the process of technological progress. The appropriateness of technology is a changing quality to be understood within the broader context of a process of development with the human being as its primary concern. The needs, aspirations, resources, and capabilities of a population at a given moment are important factors in determining the worth of a technology, but they have to be examined in light of their contribution to the expansion of the scientific and technological capacities of the population. A simple technology is quite inappropriate if it leads to stagnation, and a complex one is appropriate if it is accompanied by learning so that the people can assume complete control. The group at the rural university thus began to understand appropriateness as a reflection of a population's systematic learning about its own path of development, in terms of which they were already formulating their concepts of education.

Viewed from a slightly different angle, admittedly a simplistic one, technology is the application of science, and science has come to be regarded as universal, the heritage of all, independent of where and by whom each one of its pieces has been discovered. Modern technology is the application of science for the development of a given lifestyle, that of the industrialized nations. Applied within the context of a distinct set of aspirations, the same science should lead to a different and more appropriate technology, helping a village be more productive or more comfortable. Achieving this does not imply the rejection of the old or the new per se nor that the adoption of technological innovation or technology transfer are mutually exclusive paths of development. Appropriateness cannot be determined by criteria other than the participation of a human population in the process of scientific search and the constant improvement of its ability to look for and try out solutions to its own technological needs.

To say that a population is engaged in scientific search is vague, but it becomes clear if it is examined from the point of view of institutional structures. A population must contain proper institutions that can lead the search, without losing touch with the realities of the region or the state of scientific and technological progress worldwide. In most rural populations, such institutions do not exist; the rural university, as a learning institution of the region, was a logical candidate to assume the responsibility and face the challenge.

The issues of appropriate technology, originally raised to answer practical questions, led the members of the rural university to redefine the nature of their work and the role of the university as a catalyst of development. The concept of education was expanded even further. The application of science, now understood as a well-organized process of search for solutions to constantly changing technological problems, became an essential component of activities along with the development of human resources and community organization. In order to incorporate this new component, a 3-year plan was adopted with the goal of installing capabilities within the rural university to promote positive technological change. Financial resources were secured for the plan from PACT (Private Agencies Collaborating Together) and, by 1979, activities were well under way.

The Practice

It was clear from the beginning that, although the development of institutional and scientific capacity implied progress at a conceptual level, the 3-year plan would have to be stated in terms of practical goals and concrete methodology. At the time, the group of professors knew little about technological innovation, but vaguely envisioned that it somehow began with the detection of a concrete technological need and passed through successive stages of search for alternatives, adaptation and experimentation, evaluation, to final large-scale propagation. The desired capabilities of the rural university could be stated in terms of the number of specific technologies it could take successfully through such a process, and the number of technologies at different stages of development with which it could work simultaneously.

One specific need — potable water — that had already been subject of study for some time was chosen as the basis for a first project, during which the nature of technological change was to be carefully examined. Too little clean water for

domestic use was a problem felt by most of the families of the area, and it had serious implications for health and sanitary conditions. The professors and the students of the rural university began seeking solutions, experimenting with, and finally selecting, simple techniques for digging wells. Every step of these activities was carefully analyzed and a basis for a methodology was developed. Subsequent projects tested and changed this methodology, until finally an overall conception of the role of the rural university in technological change was achieved.

In defining the range of the activities of the rural university, its members were careful not to duplicate the work carried out in other institutions. Their aim was to fill an institutional gap in the process of research in science and technology that should end with the utilization of appropriate technologies by rural people and result in feedback into the research and development system. With the exception of very isolated instances, a noticeable gap at the village end of the process persists in almost all aspects of technological development. For example, crop research done in international centres and universities focuses on "packaging" technology — whether it be new varieties, measures for disease and pest control, or other production practices. The packages — even the language implies a finished product — are passed to government programs with the mandate to multiply and distribute them. This one-way flow of technology and information has, to date, not created the desired changes.

The failure to improve production of the small farmer has often been explained in terms of the weaknesses of extension systems as well as the fragmentation of the entire research and development system. The group at the rural university argued that the solution lay only partially in the organization of extension and the establishment of feedback through farm trials; a new institution such as the rural university of FUNDAEC had to be added to the research–extension system to integrate the final research in adaptation of technology with other basic processes such as education and community organization. While this institution would not develop new varieties, its tasks would be far more complex than that of an extension system with a feedback mechanism, and it would need to have more scientific capacity than has traditionally been allotted to institutions working at the grass-roots level.

The nature of the scientific activities of the rural university was in itself a topic of reflection among the founders of FUNDAEC. It was strongly felt that technological change was not enough and that the next decades of scientific research would have to lead to new and unimaginable scientific breakthroughs that would make possible the development of an entirely different set of technologies. To use Thomas Kuhn's terminology, the whole field of science seemed to be in crisis, at a stage that had to lead to change of paradigms and to a series of scientific revolutions. For example, agricultural sciences probably needed to abandon their primary method: study of two or three factors of production while all other parameters are kept at an optimum under almost perfect conditions. Health and medicine were already undergoing profound changes, and the energy crisis was forcing everyone to take a new look at the whole issue of technology almost in every field of endeavour.

None of the expected scientific breakthroughs could be perceived on the horizons of research. The rural university itself would probably not contribute to them in the slightest manner. It did seem essential, however, not to be bound to cherished theories, methods, and instruments and to try to generate knowledge

as freely as possible. Specifically, it was hoped that fragmentation would be avoided, although this did not necessarily imply the adoption of a holistic approach, which would have locked the group into yet another inflexible system. It seemed to the founders of FUNDAEC that science, along with other human practices — religion, family life, education, social interaction — has become fragmented, and is only responding to questions about fragments of nature, of the individual, and of human society. To content oneself with mystical statements about the whole does not necessarily remedy the situation. A hard and arduous road is ahead, and much effort will have to go into the search for new meaning and some degree of basic unity in all of science.

At the time, the professors of the rural university saw the most undesirable aspect of the fragmentation of science in the division between the natural and the social sciences. Their methodology would somehow have to avoid such a division and their investigations in technology would have to be a combination of technical research and social inquiry through action.

Defining Technological Needs

The need for better water for domestic use was obvious and had not been defined, per se, in any step-by-step method. However, it would not have been obvious if the members of FUNDAEC had not observed the daily activities of the rural families and compared the findings with technical recommendations of experts in the field of sanitation. These two steps permitted a rapid appraisal of needs with some degree of objectivity and so became the first method for detecting and defining technical needs. The group categorized the activities of the people and then conceptualized these categories into a series of chains related to, for example, raising animals such as swine, chicken, or rabbits; cultivating a crop; obtaining water for domestic use; or recovering from illness. For a number of these chains, they prepared two detailed descriptions: one corresponded to what people ought to be doing according to experts in the field and the other, to what people were actually doing in the community. Neither of these descriptions was necessarily what they considered to be the best, but by comparing the two, they always gained insight into the technological "restrictions" that the rural population faced every day.

The first chain of activities the group examined by this method was that of swine production. The modern technology includes constructing appropriate facilities, buying the best races, and utilizing a specially formulated diet; it implies so much credit and such a small margin of profit when undertaken for small numbers of animals that the death of one animal would leave a family in debt for years. The inhabitants of the region usually raise one or two pigs that freely roam the fields, receive small portions of commercial feed and whatever is available from the kitchen and the farm, and reach a reasonable weight in about 10–12 months. When sold, they fetch a price just about equal to the cost of their feed and the amount paid for them as piglets: everyone in the area knows that raising pigs is more a family savings plan than a productive enterprise.

Comparing the two descriptions showed clearly that the restrictions were not simply related to the availability of better races, as many government programs seemed to imply. Feed — its cost and market structure being designed for large enterprises — presented the greatest restriction to swine production in small family-operated units. Thus, the focus for the technological activities of the rural

university was to ensure access to animal feed costing about 30 per cent less than what was available in the market. The first efforts were a series of experiments to replace some of the feed with material more abundant in the region. These experiments were crucial, if naive, in the formulation of a realistic solution — the organization of a whole system including a plant for making commercial feed.

The same methodology was applied to the chain of activities for raising chickens, and, again, cost of feed was the most important restriction. However, constructing appropriate facilities and carefully handling some 300 chickens by a family did seem to leave a reasonable margin of profit, so that other technological needs, such as inexpensive floors, material for bedding, appropriate feeding, and watering, also entered the list of technological necessities.

The chain of activities in agricultural production gave a long list of restrictions related to irrigation and drainage, preparation of land, control of pests and diseases, harvest, processing, and marketing. About 60 needs were under discussion among the professors, students, and other members of the community. Detecting the needs had, somehow, not proved to be as formidable as much of the discourse on appropriate technology seemed to imply. Here was a long list of necessities, on which both experts and the community agreed; yet hundreds of volumes of literature and numerous experts were unable to offer solutions that worked within a complex set of interrelated restrictions.

Later, the formal description of chains of activities became less important, although it was included as part of the curriculum of the rural university so that the students could learn logical and systematic diagnosis. By being involved in development of the region, well-trained individuals gained insights into technological restrictions almost automatically, so formalizing the descriptions eventually proved to be superfluous. Technological restrictions became obvious — like the need for water — from development work that the rural university was involved in.

There were eight general-development themes the staff and students were pursuing: improvement of the flow of information and community education; establishment of microenterprises of support; improvement of services and infrastructure; child education and strengthening of families; improvement of flow of goods and marketing; creation of small units of production; and search for alternative farming systems. Thus, there was some change in focus, but the method remained basically the same.

Members of the rural university and the community worked together:

- Analyzing their production and other daily activities;
- Taking an inventory of the resources available; and
- Consulting the literature and experts on industrial processes in an attempt to find not only solutions to technological restrictions but also opportunities peculiar to the region because of its natural resources and production activities.

Searching for Solutions

Once the technological needs have been identified, people must begin experimenting with alternatives to fulfilling those needs. How much the rural university would have to be involved in experimentation and innovation was not

clear initially, and, when it became clear, was not wholly satisfactory. The basic dilemma: with their resources, the members of the rural university could not attempt to develop the capacity to experiment with alternatives, and, equally important, could not adapt, propagate, and disseminate solutions unless they developed a thorough understanding of the solutions through research. The know-how that is required to sustain a technology in a region, even in cases when it has been developed for very similar conditions, implies the existence of a group of people familiar with a large number of details who have, even for only a short time, investigated alternatives and understood the reasons behind each detail and the possibilities of small changes. Technology is not propagated by books, leaflets, bulletins, and other educational materials, no matter how well illustrated and imaginative their presentation. Although complete innovation is often not necessary in the search for solutions for concrete technological needs of a rural area, some experimentation and adaptation is indispensable if a technology is to be mastered by the inhabitants of a region and dependence on outsiders for maintenance is to be minimized.

During 1979–80, the FUNDAEC group attempted to establish a core of experts from different fields to carry out simultaneous research on the many technological needs that were rapidly being detected, but, with no institutional capital, the rural university could offer no stability to such a group. What they finally decided on as an alternative was to keep a number of professionals as members "in spirit"; they work in other institutions and are contracted by FUNDAEC when money becomes available for specific projects. The few full-time professionals follow technologies all the way through propagation, oscillating between periods of intensive experimentation and periods dedicated to the dissemination of results. This approach is slow, especially when compared with the urgency of needs, but is in line with the reality of institutions belonging to poor populations in rural regions.

Early — with the first project on domestic water — the FUNDAEC group realized that access to information worldwide was indispensable if the rural university was to become an efficient agent of technological change. Many groups reinvent what is already known by others, and much energy is lost in working with solutions that have already proved worthless elsewhere. A most important element of the 3-year plan, then, was to develop a documentation centre and incorporate it fully into technological change.

The centre began work in 1979 with the help of VITA (Volunteers in Technical Assistance) and, by 1981, it had gathered about 2500 documents in response to technological searches. The centre plays more than a passive role of offering information upon request; it monitors the progress of the search for solutions to technological needs, maintaining a file for each detected need and continuously updating it with reports of experimentation and minutes of meetings. The files are valuable for the preparation of educational material, for dissemination of results, as well as for the incorporation of relevant research into the textbooks of the formal system.

The steps in the search for solutions begin with the classification and quantification of the needs detected; move through a review of the literature and consultation with experts; analysis of alternatives; experimentation; evaluation (and, if necessary, resumption) of experimentation; testing in the community; and another evaluation. The last step is propagation, and this final step actually comprises two major avenues, with several steps.

Propagating Technology

Many groups argue that too much work has been done on the creation of technology and that the real challenge is to discover methods for the dissemination of what already exists. The fact is that, although hundreds of technologies claim to be appropriate throughout the world, only a few work sufficiently well to be feasible as alternatives to what people are already doing. This, however, does not diminish the importance of disseminating results in bringing about technological change.

The professors and the students of FUNDAEC gradually understood that propagation was not a separate, final stage of technological development but was intimately connected with community life and activities in which the need had been identified. Because the members of the rural university were involved intimately in identifying the needs, they were able to disseminate technologies much easier than had been anticipated.

Of the focuses for FUNDAEC work, the creation and strengthening of small enterprises of support proved to be the most important for technology dissemination. A microenterprise for well digging was the first to show the way, but others, such as a nursery, a plant for processing chickens, centres for breeding pigs, a feed-concentrate plant, and the enterprises for the fabrication of tin objects and chicken wire followed. Although each one has faced many difficulties and, at some time, has needed subsidy, this structure of microenterprises is slowly growing and has proved essential for technological change.

Also essential has been a program of community education to accompany all the development activities of FUNDAEC. The means and the methods depend on the nature of the technology but include community meetings and seminars; bulletins; small booklets; slides, tapes, and other audiovisual aids; and academic textbooks. The most effective methods seem to be those that combine different instruments. For example, a specific subsystem of small-farm production is one subject covered in a technology textbook for promoters, a series of booklets for farmers, and a number of bulletins as well as slides and even videotape programs to be shared with the community in special group meetings. The materials have been slow to emerge, but enough have been produced and tested to have created know-how — the foundation for future work.

Lessons from Experience: The Complexity of the Activities

The theory behind the approach taken by the rural university is straightforward. The practice is much less clearcut.

Water supply

The solution to the problem of securing a better supply of water for domestic use, at least as far as sources were concerned, was found more or less quickly. In the region, with many rivers and streams and sufficient, although irregular, rainfall, the water table is high and wells that are 7–15 m deep could easily supply a family with clean water. The commercial well-digging enterprises in the area, however, were dedicated to the construction of deep wells for irrigation of large-scale operations and charged too high a price to be considered by individ-

uals. Wells dug by hand were few because of a layer of soft sand that continuously caved in.

Within a few months, participants learned simple techniques for digging wells, using a series of concrete pipes, about 1 m in diameter, and the necessary implements, including a mould for fabricating the pipes, were constructed at the university shop. From among the inhabitants of the village who participated in experimentation with alternative techniques, one helped establish a small well-digging enterprise. The price of wells, between $200 and $500, was low but still beyond the reach of some villagers. A revolving fund was established to provide credit to families who wanted to take advantage of the service, and the small enterprise began to function well. In fact, it continues to construct wells, although not as quickly as was originally expected.

Simultaneously with the search for well-digging techniques, hand pumps were being tested. Available information had suggested that two models, inertia and chain pump, had good potential for the area so these two were selected for testing at the university shop and on some of the farms of the community. One focus was materials to be used in the manufacture of the pumps. The result was that both pumps were propagated in the villages, but the chain pump was given preference, as it could be perfected and even coupled to a motor in future.

A second small enterprise was created, but, this time, the owner did not keep up the quality of work. His pumps began to break down. At the same time, FUNDAEC faced financial difficulties and could not secure a professional to solve the many small, but important, technical problems. Further work was postponed and only now, after an examination of experiences to date, has again been taken up by the rural engineers.

The wells constructed by the enterprise were, in general, on farms where FUNDAEC had other programs as well, usually in agricultural production. A few wells were built for families that had financial resources independent of FUNDAEC. Only when a family either had some hope for increased income or had a reliable source of income would it venture into improving sanitary conditions, no matter how "real" and how "felt" the need was. This simple fact continues to be ignored by many programs, and millions of dollars are spent to improve sanitation and health without investment in income-producing activities.

Moreover, most of the families hoped that, by building a well, they would have water for supplementary irrigation. However, the hand pumps were not appropriate for irrigation, and the farmers could not afford to buy or maintain motorized pumps. One had to look, then, for a different level of solution — for example, the creation of community-owned or individual enterprises that would rent pumps to the farmers. At present, the economy in the region, especially when transportation costs are included, could not support such enterprises.

Government programs have been promoting rural aqueducts using deep wells or rivers. A few aqueducts have actually been built but have performed poorly, with neither the quality not the quantity of water reaching the desired level. The proposal to look for "smaller" solutions such as wells and canals for groups of families was rejected by government experts who channeled all available resources to the construction of aqueducts serving groups of villages. Peasants who have their own wells, as well as access to an aqueduct, use the well for drinking water and the aqueduct for irrigating small vegetable gardens. If not careful, they are fined because the aqueduct is for domestic use only.

The engineers trained at the rural university have adopted several approaches. One is monitoring and controlling the quality of water from the village aqueduct. Another is designing a model water system for a group of families hoping to use it as a demonstration. The experience has shown how complex even the most obvious needs are and how difficult promoting a simple technology is when a "sophisticated" solution is being promoted and promised by government or some other agency.

Swine production

The professionals of the rural university were aware of controlled experiments for developing new animal feeds but decided to embark on less-sophisticated research for partial substitutes from materials easily accessible to the farmers. The philosophy was to begin with what the farmers already did and try to organize it a little better.

The initial goal was to enable farmers to replace 30 per cent of their commercial feed with cheaper products. Many different products were used in the experiments which were carried out at the rural university as well as on a number of farms in the villages.

The method was simple: groups of pigs were fed diets with different percentages of substitutes (no effort was made to balance the diets) and the final profits were compared with those for pigs raised on 100 per cent commercial feed. Although the method was inadequate for scientific judgments, one substitute, *Amaranthus* sp., a common weed in the region, proved beyond doubt to be a valid substitute, bringing down the cost of feed and doubling the margin of profit. Experiments with a number of other substitutes, such as water hyacinth, were inconclusive.

Analyzing the economic details of swine production in the region; the quality, ever-increasing prices, and availability of feed concentrate; and the effort that would have to go into gathering substitutes, the researchers became disenchanted with trying to seek solutions at the farm level. They gradually decided that a more appropriate technology would be a plant for the fabrication of feed concentrate for the whole region.

Loans were secured, and a plant with a capacity of 1 t/h was ready to function at the beginning of 1982. The plant is small enough to be flexible so that experiments in the use of local materials can be conducted to keep costs down and large enough to allow promotion of swine production in units with 2–40 animals.

Raising chickens

The technological needs connected with raising chickens were highlighted by students who were working with families in the village of La Arrobleda. Here, the first set of needs was mostly related to the techniques of feeding and taking care of the chickens, building better facilities, and preventing disease. The means to fulfill these needs were easily available. Local materials were used for floors and bedding, educational material was prepared about the details of the entire process, and soon some 30 units of production were created in the two or three villages near the site of the rural university. Originally, the number of chickens at each unit was kept low, about 50–100. In spite of the high cost of commercial feed, each unit gave reasonable profits; marketing was easy, and the

chickens could be sold within 1–2 days of reaching optimal size. Experiments with substitutes for commercial feed began but were inconclusive. Like the search for low-cost feed for pigs, this effort was passed to the recently built plant for feed concentrate.

The initial success of the small units led to pressure by the families to increase the number of chickens in each unit. In response, FUNDAEC increased credit, and soon there were units of 300–500 chickens technically functioning satisfactorily. Marketing was another story, and the professionals of FUNDAEC began to spend time trying to help families sell chickens.

A small enterprise for processing chicken, freezing, and storing it seemed ideal. After about 1 year, financial support was obtained, and appropriate facilities were built. But the basic problem of securing markets for the product persisted. As FUNDAEC had to absorb the losses, the activities were temporarily put on hold.

The rural engineers wondered whether chicken raising for small farmers had to stay at the level of the few running free around farms, consuming small amounts of purchased corn for such a long time that the final cost is about twice that of chickens raised in confinement. After a year, however, they began reviving the small units of about 50 chickens. The units are scattered around the region, and much of the market is internal. The small processing plant can be geared up again whenever there is demand, and slowly an external market is being built. The investment in the plant, of course, is not paying off quickly in economic terms, but this is a fact that development plans have to learn to cope with. Someone has to invest in development; poverty cannot by itself produce wealth. The lesson about maintaining appropriately sized units was learned well. The engineers now believe that a region can have many units of about 50 chickens or a couple of large operations, but the intermediate size is bound to fail unless the infrastructure of support has been carefully planned.

Mechanical shop

The description of the search for appropriate technologies would not be complete without mention of a mechanical shop that was gradually developed at the rural university. The shop began with rudimentary equipment, basically to teach the first students of engineering some carpentry and metalwork. The emphasis was on construction of equipment that would be useful in everyday rural life. Slowly, the shop began to serve as support for most of the technological activities in the rural university. The contributions made possible by the shop range from the construction of a more efficient wheelbarrow than the one commonly used in the region to participation in the building of the plant for feed concentrate. In fact, the shop in the scheme of technological action–research has been understood mostly in terms of its role in the creation of small enterprises, the best examples being an enterprise for the manufacture of tin objects and another for the manufacture of chicken wire.

SEARCHING FOR ALTERNATIVE SYSTEMS OF PRODUCTION ON FARMS

In 1975, the FUNDAEC group began work in agricultural production, enthusiastically setting out to educate farmers in modern technology, confident that available packages with new varieties, recommended amounts of fertilizers, and improved practices would rapidly raise the standard of living of the inhabitants of the region. A few professors even became partners with farmers to experience the "miracles" of the Green Revolution. However, no miracles occurred; instead, the experience produced a long list of "things that will go wrong," and resulted in a much deeper understanding of the restrictions faced by small farmers.

Disenchanted, they strongly defended traditions. But this phase was short-lived, as this approach promises little improvement in future. By the middle of 1976, the professors of FUNDAEC were fully aware of the complexity of the many factors affecting production in small farms and were beginning to clarify some of their own concepts and convictions. Clearly, modern knowledge would be essential to improving production but so was the farmers' point of view. The farmers justifiably mistrusted the extension system that had repeatedly encouraged them to replace secure techniques with riskier, albeit potentially higher paying, technologies with inflexible management requirements.

The FUNDAEC group decided that research should address the basic challenge of incorporating modern knowledge into the small farmers' systems that had evolved because of the reality of rural life. This decision implied a search for new alternatives in accordance with the concepts and principles motivating the inhabitants of the region.

Criteria

During 1977 and 1978, a number of unstructured experiments were carried out in collaboration with three families. Underlying these experiments was a vague notion about "the organization of the farm's diversity." These 2 years were basically a search for criteria, principles, and methods, a search that finally led, in 1979, to more structured experiments in a project supported by the International Development Research Centre (IDRC) of Canada. The specific goal was to seek alternative systems that incorporated:

- A diversity of plant and animal species, crop rotation, and mixed cropping, with minimization of risk as important an issue as increased total production.
- The farmers' calendar, spreading the time, resources, and energy of the farmer evenly and constantly through the year.
- An area for production of food for the farmers' families.

• Minimal inputs with stable and maximal yields by use of appropriate technology in as many production activities as possible.

• Potential benefits not only for single families but also for community enterprises.

Other programs of FUNDAEC were, at the same time, looking for means by which groups of small farmers could obtain better credit and technical assistance from government agencies and better access to the market.

Methods considered for this project ranged from the creation of FUNDAEC-owned and controlled model farms for research and teaching to experimentation on the farmers' land. Neither was considered adequate alone because the members of the rural university needed to become involved in and understand, as rapidly as possible, the practice and the problems of the traditional systems and the means of propagating viable new alternatives.

Based on previous experience, they designed experiments with a few farmers to study and evaluate one system. The capacity to work with farmers in a joint search for alternatives was being sought; the approach being taken was the testing of a model that seemed to incorporate the characteristics identified as desirable in earlier experiments.

The First Experiment

The participants divided production into three categories for experiments:

• Animal husbandry — animals common to the region such as chickens, pigs, goats, and ducks would be selected for each farm.

• Permanent crops — traditional semipermanent and permanent crops such as coffee, plantain, cocoa, and fruit trees would be maintained as cash crops on a segment of the farm.

• Transitory crops — the remaining portion of the farm would be divided into small modules that would be planted sequentially, with crops (beans, corn, rice, cassava, etc.) designated for family consumption as well as for sale. The modules would comprise different combinations of crops with one or two modules needing planting each week and others weeding, irrigating, or harvesting. The dry periods were to be used for land preparation.

They hoped that the experimental system would differ from the existing system by:

• Ensuring continuous access to certain foodstuffs;

• Diminishing risks caused by adverse weather, plant diseases, pests, unfavourable marketing conditions, etc., which would affect only a single part of production;

• Getting the most from resources, with tasks such as cultivation, irrigation, fertilization, and pest control being done on a smaller scale and at more opportune times; and

• Diversifying by-products for use as fertilizers or animal feed to reduce overall costs.

At the beginning of 1979, 11 farmers agreed to work with FUNDAEC's agronomist in applying the experimental system. The pilot plan was explained to

them, and they accepted it in principle. A contract was drafted for each one, with FUNDAEC promising to give credit and close technical assistance and the farmer agreeing to carry out the work and help in measuring and evaluating the results. The credit had to be repaid from the sale of the products, but the farmers were not to be responsible for mistaken or unprofitable research. The form of credit was flexible and, in some cases, was equivalent to a salary until the modules of transitory crops began to produce. Such a flexible arrangement was open to some abuse; nevertheless, all but two families cooperated. Each one implemented the farming system differently, some scarcely following it and

In trials of new cropping systems, the engineer works with the farmer.

others modifying it minimally. The results in terms of increased production and income were promising.

Before

Before collaboration with FUNDAEC, a typical farming family of six, like the Zapata Abonías, would have a yearly income of about 14 000 pesos (in 1979, US$1 = 40 pesos) from their *finca*, 3000 from the sale of fruits, and the rest from the sale of some 90 kg of coffee and 75 kg of cocoa. The *finca* would also supply about one branch of plaintain a week for family consumption. The maintenance of the *finca* would give the family 20 days of work annually. The productivity of the crops, however, decreases each year, and only the favourable prices for coffee and cocoa allow the *finca* to be a continuous source of low but steady income. The animals on the farm do not constitute real income; the money spent on corn or cheap by-products of grains would be almost equal to the price of the animals at the time of sale or consumption. The area for transitory crops would not be cropped constantly. Once every two or three semesters, crops such as soybeans, beans, corn, tomatoes, or cassava would be planted, but the gains and losses of this enterprise probably average out to zero over the years. The yields of the region are below the national average and had been estimated to be 400 kg/ha for beans, 500 kg/ha for corn, 5000 kg/ha for cassava, 8000 kg/ha for tomatoes, and 600 kg/ha for soybeans.

The members of the family work outside their own enterprise in the sugar fields, in large cattle ranches, or in the *fincas* of other small farmers. An additional 32 000 pesos a year could be expected, about 16 000 from the work of the father, 6000 from the mother, and about 10 000 from the contributions of Hugo and Carmen. The total income would be about 46 000 pesos a year.

Most of these earnings are spent on food, the weekly cost being about 800 pesos. The bill would cover: rice (140 pesos); meat (180); oil (70); potatoes (30); bread (70); sugar (30); noodles (25); beans (40); coffee (15); chocolate (10); brown sugar (15); onions (8); cassava (10); tortillas (10); sardines (30); dry milk (35); candles (30); matches (2); cigarettes, tobacco (30); and soap (20). The rest of the income is spent on clothes, transportation, health, education, and recreation.

The family budget does not allow for savings or improvements in the farm, its equipment, or construction. Except for a humble house where the family lives, the farms of the region are characterized by a lack of infrastructure and working implements. Of the 11 farms contracted originally, two had wells and three had latrines, all in poor condition. None of the farms had any facilities for raising animals. There was no access to a single pump for irrigation and all of the six fumigation pumps had been in need of repair for many years. In general, the only tool owned by each worker was the machete; even shovels and hoes were scarce and were shared among a few neighbours .

During

The experimental system could not be carried out within the existing conditions of the farms. A plan was designed, then, to equip all the farms in the experiment with minimal infrastructure. This implied an expenditure of 40 000 pesos — 13 000 for pens for some 200 chickens and 4 pigs, 11 000 for fences and drainage systems, 10 000 for a well, and 6000 for the improvement of the

physical and chemical qualities of the land dedicated to transitory crops. Little was done to the *finca* as it seemed at the time that the technology for the improvement of cocoa plantations was available and could easily be incorporated into plans, once a deeper understanding of viable systems had been gained.

As the farmers did not have any savings, the 40 000 pesos had to come from credit. No such credit was available from the government agencies, credit being given usually for short terms, namely the duration of a specific crop. However, the FUNDAEC group saw the loan as a means to measure the capacity of the farmers to pay back the debt, so financial support was provided by the rural university. Credit for infrastructure, just like credit for industries or even for houses in the cities, had to be long term, managed separately from short-term credit for the operation of the different components of the experimental system.

With improved infrastructure, the typical farm needed about 31 000 pesos of short-term credit, some 10 000 for transitory crops in modules, about 9000 for raising chickens, and about 12 000 for raising pigs. With the understanding that FUNDAEC would take the risks of experimentation, the credit was made available to the farmers, and production activities were initiated.

Careful observation accompanied all actions, and the continuous sowing of crops on each farm allowed for abundant data for the evaluation of different crops, the quantification of the time spent in specific labours, the evaluation of phytosanitary problems, and an analysis of technological possibilities and restrictions.

The experiment included several crops that were already being grown in the region: beans, corn, cassava, soybean, tomato, and plantain. Three additional crops (mung beans, cowpea, and pigeon peas) were introduced. Later, in the design of fences, a number of fruit-bearing vines and trees, especially papaya (*Carica papaya*), badea (*Passiflora cuadeangulis*), maracuyá (*Passiflora edulis*), and pineapples, were also included.

The yields in the 11 small farms in the experiment increased gradually and reached acceptable levels once experience was gained in the management of the soil and also in technical assistance. In the first zone, with relatively fertile soils supplemented with the equivalent of 50 kg NPK/ha, yields were 1200 kg/ha, 2000 kg/ha, 15 000 kg/ha, 12 000 kg/ha and 1500 kg/ha for beans, corn, cassava, tomatoes, and soybeans, respectively. In the second zone, where average yields are much lower than the national average, the yields achieved were 800 kg/ha, 1500 kg/ha, 15 000 kg/ha, 10 000 kg/ha, and 1200 kg/ha. In this zone, a level of 100 kg NPK/ha and 1 t lime was used. Associated cropping between corn and beans, cassava and beans, and corn and soybean was tried in a few instances, but not enough data were gathered to be reliable.

The cowpeas, mung beans, and pigeon peas yielded well, 1500 kg/ha, 1500 kg/ha, and 2500 kg/ha, respectively, and were relatively free of phytosanitary problems; also, they showed good tolerance to the short periods of dry weather. The beans and tomatoes were the most susceptible crops, especially when planted late in the season.

In addition to cultivation in small modules, and in accordance with the small farm's activities, a number of technical experiments and studies, relating mostly to animal feed, irrigation, and specific farm tasks, were also carried out. The most urgent questions, however, were whether the system was economically

feasible and whether it was an improvement over the traditional monoculture. None of the farmers implemented the system completely or for a long enough time to give definite answers to these questions. However, the 11 farms provided sufficient input and output data for calculations of the conditions of the typical farm under study. In this case, the activities of the system occupied half the farmer's time and would earn (after payments for short-term credit and interest) about 38 500 pesos — 25 000 from transitory crops, 9000 from chickens, and 4500 from swine. From this income, the farmer would have to pay about 11 600 toward the loan for infrastructure. The remaining 26 900 pesos, divided by about 170 days of work would give a salary of 158 pesos/day, 44 per cent over the minimum wage of 110 pesos/day. Even if outside earnings were nil, total income would increase during the first year by about 8000 pesos. There would still be opportunities for outside work, with potential earnings of 5500 pesos if the farmer worked about one-third of the remaining time.

These results did not imply substantial improvement in the farmer's living conditions and, among other things, indicated need for a larger land area and improved systems. The improvement, however, seemed to be sufficient to justify the continued search for alternative systems based on the same principles of crop diversity and organization of the farm routine.

Subsystems: a new vision of the search

The 2 years of intensive work with the initial experimental model provided FUNDAEC with many insights into possible alternatives for production and, at the same time, led to a deeper understanding of the restrictions that efforts to improve living conditions in the region would have to face. The greatest restriction faced by the farmers in Norte del Cauca is undoubtedly the size of their land. The inhabitants have gradually lost their land to the agroindustrial complexes, as Colombia has become "more developed." The process deserves detailed analysis, but the size of the smallholdings is a factor outside FUNDAEC's mandate. Other restrictions to improved farming originate from the complex social, economic, and political relationships already in motion in the region. Slowly, strategies to overcome a few have emerged.

The experimental model itself had shortcomings: from a financial point of view, although profitable, the system needed too high and too rapid an initial investment; from a management point of view, it was too complicated: the farmer could not easily cope with so much change as fast as the success of the system required.

A few months of analysis at the end of the 2 years finally led to a new vision of the search for alternative systems as sums of subsystems rather than sums of single elements. A subsystem by itself contains a few plant and animal species but its degree of diversity is far less than the total number of possibilities open to the system. Initially, a subsystem is established on a small portion of the total farm — a few hundred square metres of some related crops with or without a corresponding area for animals. Each subsystem involves intensive use of the land including the utilization of fences for production. Work with each subsystem occupies only a portion of the farmer's time, and by itself is economically profitable.

Continuous, organized work on their own farms required too many changes in the farmers' lifestyle, but subsystems that leave time for other economic activities

seemed ideal. The capital investments would be smaller and more accessible, and the FUNDAEC group hoped that the farmers would slowly develop systems incorporating subsystems suitable to their specific conditions and desires. This strategy avoided a common pitfall of development programs: that of viewing the inhabitants of a region as a homogeneous group of people and offering the same solution to all of them.

The FUNDAEC group drew up a list of 21 subsystems that, according to data on hand, seemed feasible (Table 1). The second semester of 1980 saw the first subsystems operating in farms of the region. By mid-1982, many had proved agronomically and economically profitable. They were manageable as a vehicle not only for farmers but also for educators: work on a subsystem became part of the curriculum for promoters, and students had to undertake a detailed analysis of a subsystem.

Analyzing and Modifying a Subsystem: The Students' View

In lesson 1, the potential promoters of rural well-being make a list of some of the most common crops in the locale and describe one of the principal activities in agricultural production. Afterward, they begin to study the actual production of a number of crops. They write down their ideas about "systems of production" and read a FUNDAEC technological report. The report summarizes FUNDAEC experiences searching for techniques and methods to improve production. It explains efforts in the search for alternative systems, and the emphasis on the conditions, culture, and choices of the people of the region. It begins with definitions of some fundamental words like monoculture and polyculture. It also focuses on the idea that different techniques can be used to accomplish the same tasks — for example, preparing land by machine or using herbicides. It covers the *finca* as a system of polyculture that farmers have used for generations and provides a little history to show how, in the recent past, local farmers had moved from polyculture to monoculture with unsatisfactory results: many farmers lost their land because of the money they had borrowed to make the switch and because of the large risk involved in monoculture.

The report continues with a description of research activities between 1979 and 1981, introduces the concept of subsystems, and ends with an account of the activities under way with a number of specific subsystems. The students are subsequently asked to discuss the report and present detailed descriptions of a few systems of production known to them.

In lesson 3, the students begin their projects to develop their capacity to establish and care for the crops of the region, establishing a subsystem of 500 m^2 (Table 2). By lesson 10, they are ready to ask themselves how their subsystem responded to the cultural and social conditions of their community, analyzing results from the point of view of the availability of land, nutritional requirements, labour conditions, yields, etc.

Availability of land

Some discussion is devoted to why availability of land is important, the differences between 1-ha, 10-ha, and 50-ha farms, etc., before students compare the data they gathered on yields in their polyculture with results from

Table 1. Schedule of planting (P) and harvesting (H) of subsystems during the first year.

Subsystem		Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
	Rainfall (mm)	120	183	100	150	50	50	110	150	140	100	50	30	120
1[a]	maize	P	—	—	—	—	H							
	legume	P	—	—	H									
	cassava	P	—	—	—	—	—	—	—	—	—	H		
	squash							P	—	—	H			
	green beans								P	—	—	H		
2[a]	maize	P	—	—	—	—	H							
	legume	P	—	—	H									
	squash							P	—	—	H			
	green beans								P	—	—	H		
3[a]	maize	P	—	—	—	—	H							
	legume	P	—	—	H									
	squash			P	—	—	H							
	tomato								P	—	—	—	H	
4[a]	maize	P	—	—	—	—	H							
	legume	P	—	—	H									
	squash							P	—	—	H			
	tomato								P	—	—	—	H	
	cucumber								P	—	H			
5	cassava	P	—	—	—	—	—	—	—	—	—	—	H	
	legume	P	—	—	H									
	squash	P	—	—	—	—	H							
6[a]	cassava	P	—	—	—	—	—	—	—	—	—	H		
	legume	P	—	—	H									
	squash	P	—	—	H									
	pigeon pea													P —
7[a]	cassava	P	—	—	—	—	—	—	—	—	—	H		
	legume	P	—	—	H									
	watermelon	P	—	—	H									
8	cassava	P	—	—	—	—	—	—	—	—	—	H		
	pineapple	P	—	—	—	—	—	—	—	—	—	—	—	—
	watermelon	P	—	—	H									
9[a]	cassava	P	—	—	—	—	—	—	—	—	—	H		
	maize	P	—	—	—	H								
	squash	P	—	—	H									

Table 1 continued

Subsystem		Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
10[a]	plantain	P												H
	legume	P			H									
	maize	P					H							
	squash							P			H			
11[a]	plaintain	P												H
	peanut	P				H								
	pigeon pea							P						
12[a]	plaintain	P												H
	cocoa								P					
	squash	P		H				P			H			
13	plantain	P												H
	legume	P			H									
	squash							P			H			
	papaya	P												
14	soybean	P			H			P			H			P
	spinach	P			H			P			H			P
	squash						P			H				
	pigs													
15	citrus	P												
	legume	P			H									
	cassava				P								H	
16	cassava	P											H	
	maize	P					H							
	maracuya							P						
17	maracuya	P												H
	legume	P			H									
	watermelon					P					H			
18	papaya	P												
	legume	P			H			P			H			
	spinach													P
19	pineapple	P												
	papaya	P												H
	cowpea	P												

[a]This subsystem has already been established with farmers

Table 2. Sample form used for recording activities in the subsystem incorporating cassava, bean, corn, squash, string beans, spinach, and papaya.

Week		Activity	Time (h)		Input	Observations
Estimated	Actual		Estimated	Actual		
1		Plow the land 25 cm deep	24			In small lots plowing is done with a shovel and pick
1		Prepare the land, buy posts	16			Land must be sufficiently damp to be easy to work
2		Spread lime, manure, and minor elements	2		Manure (2 bags); lime (1 bag); Mg (1 kg); Zn (1 kg); B (0.5 kg)	Minor elements should be mixed with the soil
2		Complete land preparation	2			
3		Make the beds	16			
3		Set up posts for fence	8		Posts (30)	
3		Install chicken wire	8		Clamps (1 kg); malla (3 rolls)	Chicken wire with 2.5-inch mesh
4		Plant beans in all the beds, fertilize	10		Beans (3 kg); 10-30-10 NPK (8 kg)	
4		Plant corn and cassava	6		Corn (1 kg); cassava (250 stakes)	
5		Plant spinach and papaya around the fence	4		Trees (30); manure (1 bag); lime (1 bag); 10-30-10 NPK (1 kg)	
7		Fumigate and fertilize	1		Insecticide (50 ml); fungicide (50 g); Coljap (50 g)	Coljap may be used as fertilizer
8		Weed	12			
10		Fumigate and manure	1		Insecticide (50 ml); fungicide (50 g); Coljap (50 g)	
16		Weed (2nd time)	12			
16		Harvest beans	16			
17		Weed (3rd time), plant squash	12		Squash seeds (50 g)	
19		Harvest corn, thresh beans	20		Packing sacks (1)	
20		Cut leaves of corn, arrange the plants as stakes	5			
20		Prune cassava	2			Otherwise, cassava canopy would shade out other plants

Table 2 continued.

Week			Time (h)			
Estimated	Actual	Activity	Estimated	Actual	Input	Observations
20		Prune papaya, spinach	1			Focus should be to take male papayas and the main branches of the spinach
21		Plant string beans	3		String bean seed (1 kg)	
22		Fumigate and fertilize	1		Insecticide (50 ml); fungicide (50 g); Coljap (50 g)	Only the string beans and the live fence need to be fertilized and fumigated
23		Weed (4th time)	12			
33		Harvest the string beans	7			
36		Harvest the squash	1		Packing sacks (1)	3–4 gatherings are necessary
40		Harvest cassava	8		Packing sacks (10)	

Note: Coljap is a trade name for a foliar fertilizer.

monocultures. The standards for comparison in a lot of 500 m^2 are beans, 60 kg, 13 weeks; corn, 75 kg, 20 weeks; cassava, 500 kg, 40 weeks; papaya, 1000 kg, 1 year; badea, 1000 kg, 1 year; string beans, 600 kg, 6–10 weeks; and squash, 600 kg, 12–17 weeks. The students are shown how to use these figures to determine how much land they would need under monoculture to produce their yields. For example, to produce 300 kg of papaya in 40 weeks would require 150 m^2 (500 x 300/1000). Using their figures, the students discover that their yields from polyculture of 40 weeks on 500 m^2 (e.g., 43 kg of beans, 72 kg of corn, 300 kg of cassava, 300 kg of papaya, 450 kg of badea, 40 kg of string beans, and 120 kg of squash) would require 1192 m^2 in monocultures.

Nutritional requirements

Students also are asked to discuss with their friends whether producing a single crop that can be used as a source of money to buy goods or trying to be self-sufficient in food production is the best route for small farmers to take. Then they write their conclusions.

The idea that a balanced meal includes proteins, vitamins, carbohydrates, minerals, fats, fibre, and other nutrients is presented, and the students are shown a series of tables and calculations that compare the variety and amounts of nutrients being produced in their polyculture with those from the single crops.

Labour

Next, the students evaluate their subsystem from the point of view of conditions of work, recalling as best they can the activities carried out, the effort, and time. Based on their experiences, they compare the work in the subsystem with what a monoculture of the same size requires and record their conclusions. At the time, they receive some prompting — for example: "Some co-workers believe that a great amount of effort and time is being saved in a subsystem

because all the work that one does for one crop can serve for the others. Do you agree with them? Others say that it is much harder to work in a subystem because one has to think about many things at the same time. What is your opinion?"

They, then, are shown calculations made by farmers who gathered data on the time they spent on tasks in their subsystems — preparation of land 80 h, planting 23 h, care (weed control, fumigation, etc.) 68 h, harvesting 55 h, and marketing 38 h. They prepare a similar breakdown for their work, drawing on the data they recorded during the project. How to use this information to calculate their earnings is the focus of the next steps. A number of tables are presented, with details of farmers' costs (a total of 14 770 pesos) and the value of the crop (21 120 pesos). They also are shown how some of the expenses were actually considered lower (6320 pesos) because the fence and the papaya and badea trees would continue to be useful for some years. They are led the rest of the way through the calculations to how much the farmers earned (440 pesos/day) so that they can compare this amount with the pay for a day's work (250 pesos) in the region. They then make the same calculations for their subsystem.

The students also touch upon the labour requirements, with a look at the advantages in weed control provided by the ground cover in polyculture. They also are asked whether they know of studies showing that pests and diseases in monoculture differ from those in polyculture.

Market

As the last step in the cycle for crop production, the market is covered in much the same way as the other steps, with a look at what one has to know and do to sell a single product and the increased management and reduced risks in marketing various products. Also, students are presented with the possibility that the smaller quantities from polyculture can be handled directly by the farmer rather than intermediaries. They write down their opinions and then are shown a simple example of how a drop in market prices can be particularly costly to a farmer who has only one crop to sell:

> Francisco planted cassava in 500 m^2 of land in the beginning of March and calculated that in December he would harvest and sell 750 kg at 8 pesos/kg; Heriberto planted a subsystem including cassava, which he calculated would produce 300 kg. At the market, they found the price had gone down to 4 pesos/kg. Heriberto has already harvested and sold other crops from the same land. For Francisco the change in the price means a loss of 50% (3000/6000 pesos). For Heriberto, however, the cassava only represents a portion of the earnings, so the loss is 5% (1200/21 120).

The students are then asked to compare two systems of production from the point of view of the risk involved. To wrap up lesson 10, the students discuss the traditional system of production in the region, how the farmers organize themselves for work, and whether the subsystems correspond to the culture, likes, and dislikes of the community.

BUILDING NEW UNITS OF PRODUCTION

The research–action–learning package called "Small units of production" played an important role both in the education of the rural engineers and in the professors' understanding of the issues in organization of production. The activities leading to this package began early in the program as, a few months after the initiation of studies, the students were asked to dedicate their afternoons to working in groups of two with about 10 families each in La Arrobleda. They were to strengthen their relations with these families and slowly establish small projects that would help them and the community to learn together about the different processes of development. The first 2 years of this contact with more than 100 families served as a period of accelerated learning and helped everyone at the rural university to reach higher degrees of maturity. Subsequently, the method of work was formalized, and systematic research and action began in the organization of small units of production specifically for villagers who did not possess enough land to benefit from the search for alternative small-farm systems. This became one of the main areas of activity in FUNDAEC.

Associations for Production

The formal methodology was an outgrowth of the language course called "Descriptions," in which students help a number of families make detailed descriptions of their conditions and determine both their needs and aspirations, as well as the available resources. These descriptions seemed to be excellent starting points for simple projects in which one or more families would associate with a student, receive the necessary credit, and begin a small unit of production.

The difficulties encountered in the creation of associations were numerous and varied. In general, the families were so poor that significant improvements in income implied a great deal of investment, away beyond the scope of the small projects the students were prepared to undertake. Yet, the level of expectations was high, and despite many explanations about the restrictions of the program, the local people expected miracles. The FUNDAEC professors knew that the first projects of the associations had to be succcessful; otherwise, people were liable to be completely disillusioned and possibly even refuse to cooperate further. The lack of technological know-how and infrastructure, however, made every proposal a high-risk project. The very concept of associations, as defined by the FUNDAEC group, proved to be unacceptable to the majority of farmers of the region. The families agreed to associate with a student but, in general, were unwilling to enter production projects with their neighbours.

Nevertheless, with a little encouragement, about 60 associations were created and began raising chickens or swine; producing honey; cultivating fruits especially papaya; or producing a few bottles of milk a week with one or two

cows. The conditions of credit were always such that the farmer would not take much risk, and many of the losses were assumed by FUNDAEC as a cost of the education of rural engineers. One problem was that the participants did not view the association as an enterprise that could slowly build and carry on long after a project was completed. For example, three families, who had participated in a successful project raising chickens, divided everything, including the tiles and the posts of the chicken shelter. All the projects were evaluated. Comments were tape-recorded. Some information from a typical evaluation reveals the intense learning by both the student, Eliciber Mina, and one of the association's members, Olga Balanta.

The family was visited 1 week after the project ended. Doña Olga seemed dissatisfied with the small profit because she had been hoping to make enough money to construct chicken coops ("I was not able to do anything with the money I received") but acknowledged the benefits readily, noting that this was the beginning of a joint effort to raise the family income. She was also content that she had helped a FUNDAEC student gain knowledge and experience. She was especially pleased that:

- None of her animals died -- in fact, none even became ill, a result she attributed to the care she dedicated to them;
- The student recorded all the costs and benefits, an accounting she found useful; and
- She had the opportunity to work with Eliciber and to develop an honest, cooperative relationship.

She voiced some concerns that merited follow-up:

- Toward the end of the project, she felt the chickens needed a few more bags of sawdust for their bed, although Eliciber believed that the amount was sufficient for the 100 chickens;
- One neighbour had some chickens that died and doña Olga felt prolonged treatment with chloramphenicol was responsible;
- She related the low profitability of the project with the sale price (about 60 pesos/kg) of the chickens and believed she could sell them at a higher price if she took five or six chickens to the market; and
- Plucking the chickens had increased the costs, with doña Olga recruiting three people to help and the student another three.

At the beginning, doña Olga's family was opposed to the project. Her husband believed that she should spend her time doing housework and practicing her profession as a health promoter instead of taking care of 100 chickens. When the chickens were brought to the house, however, all members of the family began to participate in the project with pleasure.

Doña Olga was enthusiastic about continuing with chicken-raising projects and knew some neighbours who also wanted to begin projects with FUNDAEC. A percentage of her profits went into the association and a separate amount of money had to go to the community well-being fund. As a health promoter for 12 years, she understood well the problems and the needs of the people of the region but said that FUNDAEC should better inform people about the significance of their contribution.

The student was satisfied with his partnership with doña Olga and counted among his gains:

- Increased technical knowledge about the management of chicken-raising operations;
- Experience in working in a partnership with another person; and
- The opportunity to become a positive force in the community.

The project, after initial credit and interest were paid back, netted: a bag of feed concentrate (600 pesos); four chickens for each partner (720 pesos); three chickens consumed at the day of plucking (270 pesos); income taken by doña Olga (168 pesos); income taken by Eliciber (150 pesos).

From this total of 1908 pesos, one-third (572 pesos) went to the capitalization and community well-being funds and the rest was divided between the two partners. Based on this evaluation, the student had two recommendations "to ensure that the villagers are not discouraged in the future":

- That FUNDAEC or one of the other associations buy the leftover nutrients before ending the project so that the participants can divide the utilities in cash; and
- That the technical assistance to families include administrative matters to prevent losses such as those incurred for plucking the chickens.

The Village Store

As the number of associations gradually increased, the group at FUNDAEC began to discover methods and procedures that helped the small units produce with more efficiency. A revolving fund was created with the help of the Inter-American Foundation, and, slowly, an internal bank was created to administer the funds and the accounts of the associations. The internal bank proved to be an excellent administrative mechanism and soon helped organize all the finances of FUNDAEC, lowering considerably its overhead costs. The restrictions that continued to trouble all the associations, however, were buying supplies for the projects, and marketing the products.

Initially, the group at FUNDAEC acted as an intermediary, buying and selling for the associations. This, of course, proved to be unbearable. A series of conversations held among the students, professors, and the villagers pointed the way to the creation of a village store as an answer to the problems of the small units of production. The main objective of the store would be to provide small farmers with the necessary supplies for their projects, and, at the same time, serve as an intermediary for marketing their products. Moreover, the store was seen as a potential community centre providing credit, agronomic and veterinary services, nonformal education, and possibly transportation.

The establishment of a village store and the understanding of its functions became, then, one of the central issues of the research–action–learning package. A 500-m^2 lot was donated by doña Aura Delia Lucumí, a member of one of the associations. In July 1979, building began, and by November, the La Arrobleda store was finished, with marketing activities moving from the rural university across the road to the new location.

The village store is essential for community development.

The capital for the store mostly came from credit from the revolving fund, although the members also began to contribute through the purchase of shares. The organizational scheme that evolved is not that of a cooperative, although certain principles of cooperativism were adopted: each association of production contributed 15 per cent of its profits to the village store to create a community well-being fund managed by the small board of directors elected each year. From the profits of the store, also, 30 per cent was subtracted for capitalization and 25 per cent for community well-being, and the rest was divided among the shareholders.

The experience with a village store in La Arrobleda and later stores in other villages has convinced the FUNDAEC members that a market is one of the essential structures for organized production at the village level. In time, it can increasingly take on functions for community development. However, the regional infrastructure to support a network of many interacting village stores and community centres is far more complex than what FUNDAEC could offer with its meager resources. Poverty — even with the good intentions and activities of villagers and technicians from outside — cannot generate wealth. Re-

sources from outside need to be invested if the systems are to function and progress. Nevertheless, efforts to understand marketing for small units of production were not wasted. The early graduates of the rural university consider this aspect of the research–action–learning package as one of their most valuable educational experiences and continue to try to organize mechanisms for the purchase of supplies and the marketing of products in the villages they now serve.

The Microenterprise of Support

The first village store and the strategies to solve marketing problems allowed everyone at FUNDAEC — students and professors alike — to focus on other important mechanisms, all related to the organization of production. Among these, microenterprises of support gradually emerged as fundamental; many of the later activities of the research–action–learning package were dedicated to their establishment. The impetus for the activities came from two directions. On the one hand, there was a push from the search for technical restrictions and solutions, the well-digging enterprise proving the usefulness of such an approach. On the other hand, there were theoretical considerations about the independence of the rural population. The group at FUNDAEC was not promoting isolation but wanted to help people avoid being used simply as producers of primary goods for an urban market. Somehow, the structure of production and the services existing within a population of 100 000 had to be far more complex than either of these versions of rural life and agricultural production.

At the time, microenterprises, especially in urban areas, had already attracted the attention of many agencies and programs. Almost all these programs emphasized employment. Development personnel recognized that small investments in microenterprises, with the right touch of technical assistance, especially in management, created many more jobs than investments in high-technology complexes. Moreover, the owners of microenterprises proved to be low-risk candidates for credit. Development programs supporting microenterprises, then, were designing ingenious methods to make more and more credit available to small businesses and were developing their own capacity to offer technical assistance, at a low cost, accessible to the class of entrepreneurs they wished to strengthen.

Although the philosophy at FUNDAEC was closer to this mode of operation than to earlier approaches to development, the professors had difficulty accepting theories of development that centred on only three basic ideas — employment, income, and the production of goods. Moreover, they realized that the profound differences between urban and rural life would affect the strategy. For example, establishing an enterprise to produce parts for a shoe factory in Cali was not in keeping with their ideas of development, although it created employment for those involved. To the FUNDAEC group, this type of microenterprise was another version of the expansion of industry to newer horizons always in search of cheaper labour.

For a few months, analyzing such issues was the main activity of the "Small units of production" package. The group finally decided that the small resources of FUNDAEC would be devoted only to enterprises that somehow supported self-development of the local people — that is, served the well-being of the

population. The role that FUNDAEC took on is clear from some examples of microenterprises it supported.

Sofonías Banguero, a 42-year-old resident of El Crucero, is the owner of the enterprise for the excavation of wells. Sofonías had some previous experience, dedicating part of his time to agriculture and part to digging wells in a few neighbouring villages. However, he faced many problems; on the one hand, he lacked the necessary equipment, and on the other, his rudimentary technology did not allow him to dig deeper than 4–5 m.

For 5 months, Sofonías worked with one of the engineers from FUNDAEC, Mauricio López, analyzing and trying out possible methods for excavation. Then they gathered the equipment, much of which had been built at the FUNDAEC shop, arranged a 500-m^2 lot, and opened their enterprise "Pozos Extrarrápidos." Sofonías proved to be highly capable, alert, hard working, and extremely trustworthy. He used the revolving fund of 100 000 pesos efficiently to construct wells for the villagers during the first 2 years of his enterprise. Later, the government-supported aqueduct in Caloto raised local expectations that water would soon be readily available. He built occasional wells and diverted most of his resources to building 4- and 6-inch (ca 10- and 15-cm) cement pipes for projects throughout the region.

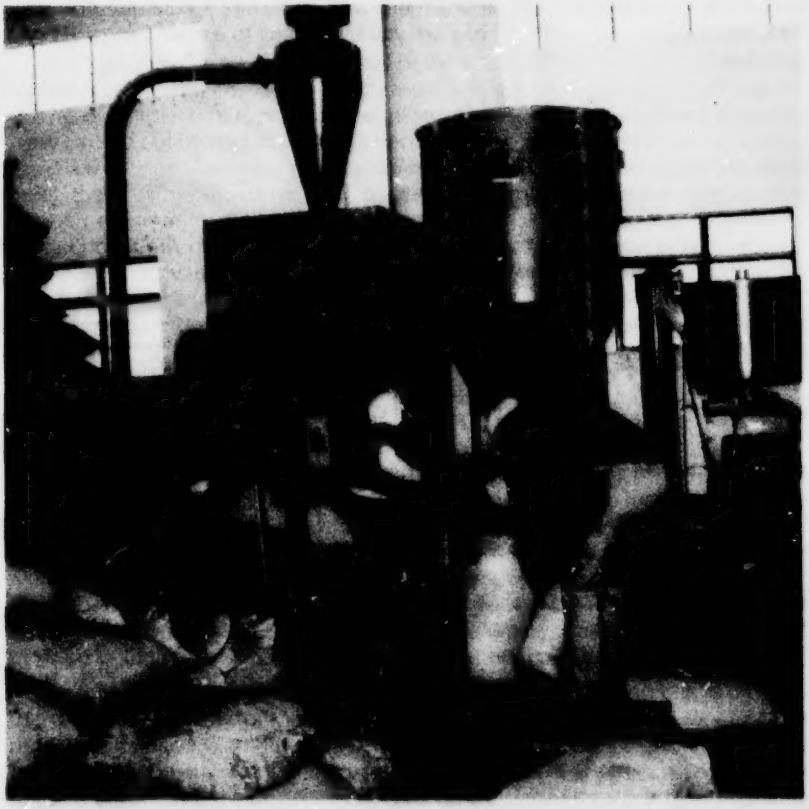
Florentino Paz and Misael Caicedo, residents of Palestina, had spent many years making moulds for baking pastry. They bought the materials in Cali and sold their products in Cali, Popayán, and Santander. Although they worked in the same house, each conducted his own business, buying material from different suppliers and selling to his own particular clients. Moreover, Misael owed money to Florentino who had been his teacher and had taught him the simple technology they both now used.

FUNDAEC chose to support this microenterprise partly because of the possibility of producing feeders for chicken-raising projects. The two men formed an association and received a credit of 80 000 pesos from the revolving fund. The FUNDAEC shop was available to them to improve the technology, a goal achieved easily. The enterprise increased production rapidly, and success seemed certain. The student of rural engineering in charge of the technical assistance decided to decrease the frequency of his visits. Soon after, the entrepreneurs decided that 80 000 pesos of inventory was too high and they could invest 60 000 in two pieces of land for their future houses. Later, differences arose between the partners, the enterprise entered a period of crisis, and was even unable to pay the quotas of the original loan. Finally, Florentino bought Misael's share and began to work alone. The group at FUNDAEC decided to continue supporting him until the new enterprise was once again on its feet, a task that was accomplished within a year.

Jairo Balanta, a 22-year-old man, was a student at FUNDAEC's promoter level and was having difficulty securing a job when he learned about an apprenticeship at the mechanical shop in FUNDAEC. There he participated in a project to develop simple and inexpensive methods for making chicken wire for fences. To support the chicken-raising projects, Jairo asked for support in setting up an enterprise for chicken wire. The market for the product, however, proved to be lower than estimated so that it occupies only part of Jairo's time. He also works on his family's farm, participates in the affairs of the community store at his village, and studies at FUNDAEC.

The Graduates' Association

The research–action–learning package "Small units of production" and especially its microenterprises of support, probably had the greatest influence of all the educational activities on the future of the rural engineers. From the beginning, the professors sought individuals who would maintain independence from the bureaucratic programs of development, would work directly as members of rural communities, and would represent the authentic wishes and aspirations of a rural people. The educational system, with its well-defined purpose, had little difficulty strengthening such a desire in the student; the basic problem was finding sources of income for the work of the future engineers. At first, the small associations of production seemed to give reasonable answers to this basic challenge of creating an entirely new profession within the rural region. After about 2 years, however, the FUNDAEC group knew that such a scheme could never offer an engineer a comfortable income; one would need 20 per cent shares in more than 100 units of two pigs each to have an income equivalent to that of a rural teacher with a comparable university education.



The animal feed mill is an enterprise that was developed to support an earlier enterprise, swine production.

In contrast, the microenterprises of support offered excellent possibilities for future work. In 1981, three engineers began to administer the piggery gradually developed at the rural university for experimentation with animal diets. Managed as a microenterprise, the piggery efficiently strengthened swine production in the region and, at the same time, generated income for the engineers. This experience proved particularly satisfying, and now that credit has been obtained for the establishment of a plant to produce feed concentrate, there is real hope for the future.

A major task, however, is to develop an organizational scheme for such enterprises and arrange for the funding, without changing the direction of the activities of FUNDAEC and its graduates for the well-being of the population. The scheme considered most workable is a nonprofit association of workers devoted to rural well-being. With capital of about US$200 000, the association could become an investor–partner in enterprises such as the plant for feed concentrate. The profits of the association, which is directed by an elected board, are invested in village development projects that include salaries for the work by association members. The scheme is similar to the one used within FUNDAEC after 1981 in dealings with the rural engineers. The engineers see their association as finally providing them with an answer to the question they have been asked repeatedly: "How are you ever going to earn a living after you graduate?"

ORGANIZING COMMUNITY ACTION

Community organization, the third component of the strategy of the rural university, is somewhat difficult to describe as it includes many aspects from the other components of FUNDAEC's strategy — the development of human resources and the application of science and technology. For most people, community organization is invariably related to group action, and, in countries like Colombia, where cooperatives are popular (but not necessarily successful), it usually implies cooperativism. The early discussions of community structure in FUNDAEC also centred on these concepts but, within a few years, the group had broadened its version and was defining this third component of strategy as the organization of the interrelated set of development processes that the rural university was to set in motion, and the creation or strengthening of the corresponding institutions.

During the first years, the members of the rural university tended to limit the activities within this component to the examination of existing processes and the testing of simple schemes of cooperation. Almost exclusively, these activities were carried out by students of engineering in the block of community service as research–action–learning packages, especially within production in small units, the possible structures of associations for production, marketing systems through community stores, and small industries as technological support for production. Only now, as the engineers establish programs in the villages and set in motion many of the most important processes of development, can an accurate account of community structure, as envisioned in the rural university, be presented. A look at the scheme of activities of the rural engineers during their first 2 years of supervised work and residence in their villages provides the background.

Zonal Projects

As the first class of students completed their 6 years' training in mid-1981, they would begin a crucial test of the validity of the strategies of the rural university. To prepare for this new stage, toward the end of 1980, the future engineers divided the region into seven zones and agreed on who would take responsibility for work in each. A zone consisted of 3–10 villages, each with about 100 families; the students in groups of two or four would be serving areas in which about 2000–6000 people lived. How FUNDAEC could play a catalytic role in support of these graduates was a focus of work at the end of 1981.

The scheme that finally evolved was based on a series of consecutive projects that the rural engineers prepared on behalf of their villages for 6–12 months. The professors worked with the students to prepare the first set of projects, a final stage in the education of the engineers. The second set of projects covering the last part of 1981 and the beginning of 1982 was designed mostly by the engineers with some assistance from their professors and many inhabitants of the villages. A third set of projects beginning in June of 1982 was far more elaborate and

tended to include the aspirations of many families who were involved in different projects with the engineers. The professors hoped that the projects for each zone would gradually include more and more of the aspirations of the inhabitants of the villages, in accord with the principle that participation is not merely a technique but an unfolding process, in itself the motive and the outcome of continuous learning, which utilizes knowledge and experience from within the community and from without and is maintained by constant development of community structure and organization.

The majority of the projects describe activities from three points of view, direct work with specific families, the expansion and organization of interrelated development processes, and the generation of knowledge for the formulation of improved strategies (see appendix). The first series of activities seeks to continue building the pyramid of workers for rural well-being, which began 6 years earlier with the training of the engineers. The aim is to endow the region with promoters, technicians, and engineers, with special emphasis on the promoter. A sustainable flow of students — 30–40 promoters/year — is the goal. Promoters constitute a corps of workers with a basic education for village life, and the engineers are contemplating additional short training courses in specific technical fields in order to increase their opportunities to earn a living.

The training at the village level is loosely organized and does not require the development of new structures. The corresponding regional structure is the rural university itself, which monitors the process, offers special seminars to students with high numbers of points, and finally has the responsibility of choosing from among the promoters those who will continue to become technicians and engineers.

No funds have yet been secured for the initial stage of action–research that would lead to a clear strategy for the organization of the education of children. The actions of the rural engineers in their zones are largely informal. Once they have a clear mandate, they will work toward creating new structures, such as a centre for preschool children and clubs for adolescents. They will also attempt to reshape or strengthen relationships of parents with formal and nonformal education. This field in Colombia has some positive experience to its credit already, and all of the participants of the rural university are attempting to build on these, linking the promoter curriculum into an innovative primary school program, "Escuela Nueva."

The relative success of the search for alternative systems of production in small farms has led the engineers to view the search for and propagation of such alternatives as a high priority. The projects by engineers for the first semester of 1981 included one or two experiments with subsystems, in which farmers participated to make technological adjustments. Subsequent projects have increased the number of participating farmers as well as the area under intensive production characterized by subsystems.

The structures needed for engineers to continue the research have already been put in place, but basic social structures, particularly land tenure, are so inadequate that the villagers throughout the region have little latitude for improvement. Such social restrictions, away beyond the sphere of action of the rural university, make the task of catalyzing development slow and difficult. A similar inadequacy in the infrastructure for drainage and irrigation at the regional level renders local solutions in each farm costly, beyond the means of the small farmers.

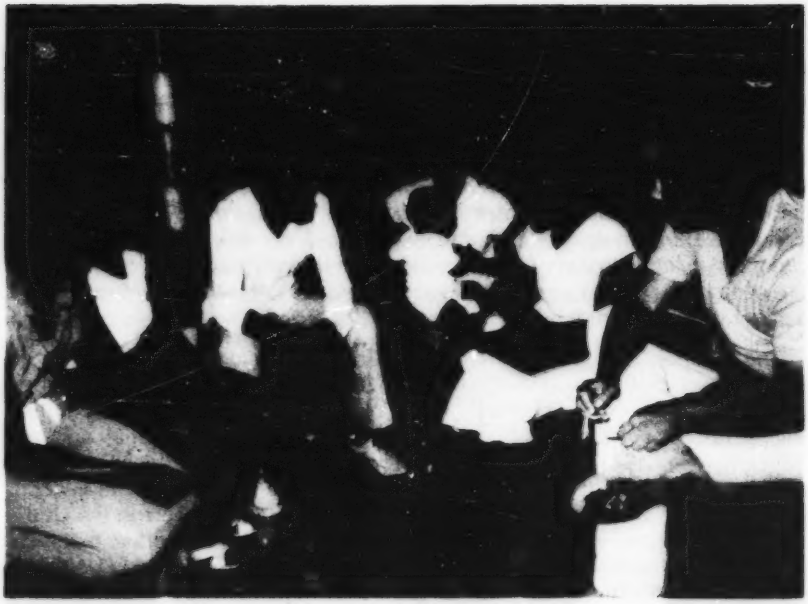
Early in 1982, the rural university had completed its 3-year plan to develop students' capacity to search for solutions to technical problems. Much of the work for detecting needs and propagating technical means to meet them is carried out within the overall strategy, but direct activities, such as the dissemination of technical bulletins, form an integral part of the projects.

The flow of information, both vertically and horizontally, has been a concern of all engineers. A few projects have already adopted goals of establishing an information post as an element of the structure of a village to be connected to the documentation centre at the rural university. These information posts have promised in future to serve as centres for community education. The appropriate use of modern communication methods and equipment in these centres is now a subject of careful study at the rural university.

The experiences in the research–action–learning packages have led the engineers to include the creation and the strengthening of small units of production as another process in their overall strategy of development. Specifically addressing the needs of villagers without sufficient land for farming, the small units are concerned with the production of simple commodities such as chickens, honey, swine, etc., and do not constitute full-time occupation. They are, in general, established as associations between families and rural engineers in which the family contributes with space and labour, and the engineer offers technical assistance and access to credit from different sources backed up by a FUNDAEC guarantee fund. The association in general complements the income of the family up to 10 per cent. The FUNDAEC group considers the small associations — with or without direct participation from the engineers — to be a pillar of community structure itself. The projects so far have established a goal of 200 such units by the middle of 1983.

A sixth process present in many of the projects is the creation and the strengthening of microenterprises largely dedicated to technological support of agricultural and animal production. The number of these enterprises is not large, and their creation is subject to the progress of other goals within each zone and the successful adaptation of technological solutions to the conditions of the region. The share of the rural engineers in these enterprises is, in general, larger than in other productive units and, in fact, much of their hope for financial self-sufficiency lies in their participation. Some 10 such enterprises, including a small plant for processing chicken, a shop for the production of chicken wire, and a tree nursery are already beginning to function, and others will gradually be established as technological restrictions within other processes are examined and adequate solutions are found.

Throughout their education in the research–action–learning packages, the students of engineering worked diligently for the creation of a community store in the village of La Arrobleda and examined carefully its possible functions. They are now applying their experiences to create similar stores in each village as a first step toward the organization of the marketing system. The small units of production, farm systems, support enterprises, and, in general, the families participating in the programs of the rural university jointly contribute to the community store, which is governed by an elected board. The community store has been a remarkable achievement in group action within a population that has had bitter experiences with associative forms of organization. It is hoped that it will lay the educational groundwork for higher degrees of organization.



The village store forms a centre for community meetings.

The activities by no means exhaust the list of interacting processes that, like threads, weave together and constitute steady progress. New directions are, however, well beyond the institutional capacity of the rural university. Isolated actions aimed at the strengthening of government services, especially in health and education, are present in some of the projects of the students. Cultural enrichment is considered an important component of the overall mission of the rural engineers and should be an integral part of their lives in the villages. The programs and projects encourage a high degree of participation by all individuals and families, but even a casual observer cannot help but notice the lack of formal group participation in decision-making. All who have been a part of the rural university have been cautious, seeking a slowly developing structure based on concrete educational and productive actions. Whether they are correct is still uncertain. That they have managed to grow from an insignificant project to an important institution in the region, under adverse conditions, may speak for the wisdom of their cautiousness.

CONCLUSIONS

By mid-1982, FUNDAEC was well immersed in the activities of the 3 years it had designated for autoevaluation and transition. In about a decade, it had grown from a small educational program into a well-established and stable institution. It had generated knowledge and formulated strategies, at least some of which had proven valid. Not one of its 22 graduated engineers had left for the cities, nor was there anyone who could be described as a frustrated, bitter, overeducated villager. The response of the population of the region to the concepts and the plans of the rural university continued to be positive, and each village where programs were established was gradually increasing its participation.

The originators of FUNDAEC had initiated their work not with elaborate theories of development or long lists of objectives and goals, but with a set of deeply rooted ideals and convictions. Among these were the firm belief in the potential of rural youth and the hope that human resources for bringing about change would be found among the peasants themselves. The institution that embodied these ideals was the rural university where modern science and human tradition could meet with dignity and interact harmoniously.

The rural university, more than a place, was a social space in which the learning process of a rural people about their own development could be systematically pursued. Gradually, this learning, which the originators of FUNDAEC believed to constitute the core of development became their sole concern, and around it they formulated the concepts of the rural university as a catalyst to the development of the region. The basic strategy that emerged, as the professors and students of the rural university worked in the villages of Norte del Cauca, implied continuous study of the processes of community life, such as production in small farms; production (usually of animals) in small units by those who do not possess land for farming; technological support to production through activities such as processing of agricultural products, construction, or the repair of tools; marketing and the flow of money and goods; development of human resources; socialization and child education; decision-making; and flow of information. For each one of these processes, a corresponding "learning process" was set in motion in an increasing number of villages to look for alternatives and to influence the direction of development. The underlying assumption has been that these "learning processes" can generate social forces within the rural population to counteract the present forces of disintegration.

The future plans at FUNDAEC are for the consolidation of work in Norte del Cauca and expansion to other peasant populations. Training for promoters of rural well-being through the tutorial system (SAT) is expanding rapidly in a few neighbouring regions. Some 90 units of coursework, constituting the entire rural high-school curriculum, are being finalized, making the transfer to the official rural system in many parts of the country a real possibility. Increasingly, grass-

roots organizations are approaching FUNDAEC with special interest in SAT and some of the results of the process of the search for small-scale production systems. The association of workers in rural well-being is slowly consolidating and taking on development projects. At an international level, FUNDAEC is collaborating with similar institutions to share experiences and improve its methods and its content. Everything seems to indicate that the future is promising for the institution.

FUNDAEC has known great success, and its members have gained valuable experience; whether the learning can generate enough force to counteract current forces of social disintegration is another question. Strangely, from among the individuals and institutions who have helped FUNDAEC, its originators are probably the most critical and the least optimistic in this respect. The hundreds of millions of rural inhabitants of the world are oppressed by a world system consisting of two strong contending powers and their many subsidiaries and variations. By simple inertia or by design, the fruits of labour from these millions are collected to finance the maintenance of the world system and its favourite occupation, the production of weapons. For the inhabitants of Norte del Cauca, a simple transfer of a sum of money from one bank to another or a political alliance at a moment of convenience generates irresistible forces that determine the prices of their products, how much land they can possess, what technology they can use, and which propaganda will be used to mobilize them. The people of Norte del Cauca, on the other hand, have proved with FUNDAEC that, once offered viable alternatives, they are willing to participate in change. Yet, their participation is only half of the challenge of development; the so-called developed world, including the modern sector of Third-World countries, also has to change. In the final analysis, a prosperous village in Norte del Cauca can only exist as an organic part of an entirely new world order.

APPENDIX: EXCERPTS OF A DEVELOPMENT PROJECT

This project is for the development of zone 4 and is presented to the directors of FUNDAEC for their consideration.

General Information

Zone 4 includes Caponera, Guabal, Barragan, Mingo, Cabito, and Quintero. The engineers in charge of the project are Mr Alirio Sanchez, Ms Eida Nur Mina, and Mr Luis C. Cajiao. The duration of the project is 1 year, beginning 1 June 1982.

The activities have as their objective the setting in motion of a series of processes that should lead to the improvement of the well-being of the inhabitants of the zone.

The Integral Development of Families

There are 25 families identified, up to now, as potential resources. [A list of the families follows, with a schedule of activities and specific goals to be pursued during the year, including an initial description of the resources and the aspirations of the family and the detailed agreement between the family and the engineer.]

The aims of direct work with them are to:

- Help them realize their potential as resources of the village;
- Help them learn new production techniques;
- Help them take advantage of the resources they already possess, for their own benefit and that of others;
- Improve the physical conditions of each home to achieve better sanitation;
- Promote the intellectual and spiritual development of all the members of the families to achieve greater harmony; and
- Foster in these families the spirit of service.

[A more detailed list of possible activities to be carried out with each family then follows. These include the establishment of subsystems and units of production, educational activities of SAT with certain members of the family, and other activities related to the specific conditions of each family.]

Establishment of Development Processes

The activities to support the pyramid of workers in rural well-being are to:

- Achieve a high degree of understanding of the educational material by the students and lead them to apply what they learn;
- Develop in the students the capacity to detect specific needs in the community and participate in the search for solutions;
- Develop in the community an awareness of the worth of its own human resources;
- Awaken in the students the spirit of service to the community;
- Motivate the students toward the acquisition of new knowledge;
- Prepare individuals who can establish productive agricultural projects using appropriate technologies; and
- Prepare individuals who can help others in small production units.

Goals for 1 year are to:

- Finish the promoter course with 10 students;
- Help 8 students reach 300 points;

- Help 7 students reach 200 points; and
- Help 20 new students reach 50 points.

Also related to the development of human resources are goals to:

- Establish classes for children in the villages of Guabal and Caponera including activities with preschool children; and
- Obtain materials on bakeries and study them with Nelson (a student of SAT) and arrange for him to work as an apprentice in a bakery with the aim of establishing one in Caponera.

In the search for and propagation of alternative systems of production in small farms, we aim to:

- Involve farmers in scientific investigation;
- Utilize subsystems for community education;
- Increase the area dedicated to subsystems in the region;
- Change the dissatisfaction with agriculture that exists in the region;
- Increase the production of food in the zone;
- Contribute to scientific advances that are applicable to the region; and
- Study different combinations of subsystems to design systems for the farms of the participating families.

Specific goals are to:

- Continue work with the present subsystems established in the farms of don Tintiliano, don Milton, don Roman Cajiao, and don Manuel Carabali;
- Establish 10 new subsystems; and
- Utilize the land of doña Lenila to establish subsystems with promoters of rural well-being in the course of their education.

Efforts to detect specific technological problems, to experiment with solutions, and to propagate results, will focus on:

- Educating the community in aspects related to sanitation and the improvement of health; and
- Disseminating the results of previous research.

Specific goals are to:

- Establish an information post in two villages, Caponera and Guabal;
- Continue with the varietal trials with beans on farms;
- Continue with the experiments with partial substitutes for feed concentrate in swine production;
- Present at least three slide programs related to health and sanitation in Caponera and Guabal;
- Present at least three slide programs related to technical problems of common crops; and
- Hold one community meeting each month to discuss technological bulletins, show slide programs, etc.

To expand and strengthen small units of production, we aim to:

- Offer landless families alternatives for generating income;
- Increase the production of animal protein;
- Promote use of the untapped resources of the community;
- Provide materials for microenterprises of the region; and
- Use these units as instruments for the education of the promoters in the communities.

Specific goals are to:

- Establish one small unit for swine production with don Dioclesiano in Caponera;
- Establish five more units, four with swine and one with chicken in Caponera; and
- Continue with two existing units in Guabal and establish two more.

For the microenterprises of support, our aims are to:

- Encourage microenterprises as a means of propagation of appropriate technologies; and
- Utilize the resources of the region.

Specific goals are to:

- Establish a bakery with Nelson Chara; and
- Help Jose Daniel to enter as an apprentice in the mechanical shop as a step toward establishing a microenterprise.

For the marketing system, our aims are to:

- Strengthen the community store as the first step toward a better community organization;
- Provide the community with basic products especially for agricultural and animal production; and
- Increase participation in projects of benefit to the community.

Specific goals are to:

- Present each month the balance of activities of the stores in Caponera and Guabal;
- Hold monthly meetings of the directive boards; and
- Make arrangements with PAN (government program for improving nutrition in the country) to use the stores as centres for the distribution of special foods.

Generation of Knowledge

In addition, we will undertake studies aimed at increasing knowledge of the rural university and region about development. Specific goals are to:

- Learn, in detail, a system for the purchase of materials for the feed-concentrate plant (L.C.);
- Define the administrative and accounting system for the community stores (E.N.);
- Learn about the common problems of cattle in the region (all three);
- Determine the best available varieties of common bean for the zone (L.C.); and
- Look for scientific seminars of interest in institutions of nearby regions and participate in at least two (all three).